THE TECHNIC OF LOCAL ANESTHESIA

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FOR FIVE YEARS RESIDENT OF THE HALSTEAD HOSPITAL

A VETERAN OF TWO WARS

IN WAR OR IN PEACE A TRUE SOLDIER ALWAYS

PREFACE TO SIXTH EDITION

Once a book has survived five editions, it is said the author has no need for apologizing for his work To do so would be to reflect on the judgment of those who had acquired it

This edition has been revised in part, simplified here and there, and some material has been added

Spinal anesthesia has largely replaced local anesthesia for operations below the diaphragm Because of this, the chapter on spinal anesthesia has been carefully revised by Dr Irene A Koeneke Though the chapter is brief, it covers all the practical points required for the use of this method of anesthesia

ARTHUR E HERTZLER

PREFACE TO FIFTH EDITION

The repeated calls for new editions encourage the hope that the technic described therein is finding some favor This work differs essentially from other books on local anesthesia in that it recommends the use of minimum amounts of solutions, not because of safety, but because a more accurate technic is possible than when large amounts of liquids are injected haphazardly

It advocates infiltrative anesthesia rather than regional blocking because constriction of vessels is secured thereby which aids in exact anatomic operating

The growing use of spinal anesthesia is limiting very markedly the use of inhalation anesthesia It is also superseding infiltration anesthesia for major work on the lower abdomen and the lower extremities Dr Arch L Spelman, on the basis of an *experience of some two thousand cases, has rewritten this chapter* Dr Raymond F Gard has added a short chapter on intravenous anesthesia

It is hoped that this edition may retain the measure of favor that has been accorded the previous ones

ARTHUR E HERTZLER

Halstead, Kansas

PREFACE TO THIRD EDITION

In presenting a new edition of this little book on Local Anesthesia, the aim has been to retain the general plan of the previous editions The technic of local anesthesia has now been standardized, so that the essential features can be presented in small space It has been my aim, however, to present the technic which I have found useful without any attempt to conform to the technic of others

It is now generally known that any operation can be done under local anesthesia, hence the striving after melodramatic effect, by presenting pictures of patients wearing a smile while their guts are being slashed about, in order to impress the reader with the scope of local anesthesia, is no longer required

Since the planning of the operation is more difficult than the technic of anesthesia, I have endeavored to present the difficulties likely to be encountered in order that the beginner may take stock so as to determine whether or not his experience warrants the undertaking

I have also attempted in a general way to present the indications for the use of local anesthesia It is not a stunt to be performed as an athletic event, but it is to be selected only in so far as it is the best for the patient It is the proper selection of method that marks the skilled surgeon and not his ability to do certain things with local anesthesia

In hewing to these simple narrow lines I hope that this little book may continue to find a place in a field occupied by many larger and more pretentious books

ARTHUR E HERTZLER

Halstead Kansas

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CHAPTER I

DRUGS EMPLOYED

Much energy has been expended in the search for a drug that is both efficient and safe for the production of local anesthesia None yet discovered meets all requirements So far as the needs of the general surgeon are concerned, however, the quest was all but ended in the discovery of novocaine It is safe and efficient within the limits required for local anesthesia For special purposes, it has its limitations and our armamentarium can with advantage be supplemented by other drugs For this purpose cocaine is the most efficient drug and when used with care is reasonably safe Percaine and nupercaine have been entered as rivals for the drugs just named Quinine and urea hydrochloride is now but little used but still is worthy of consideration Diothane, the newest candidate for recognition, has some distinct advantages Other drugs, formerly given consideration, now are worthy of mention as only of historical interest

Novocaine (Procaine)*

Novocaine and its prototype, procaine, are now almost universally used for the production of local anesthesia Used by injection it is as efficient as cocaine and much safer It is stated that it is seven times less toxic than cocaine and that fewer persons possess a susceptibility toward it Because of its slight irritability and the rapidity of its action, together with the comparatively bloodless operative field produced by the

*We have it on the authority of Julius Stieglitz chairman of the Sub-committee on Synthetic Drugs National Research Council (Boston M & S J 1918 clxxviii 916) that procaine is identical with novocaine Inasmuch as this is the proper name for the American product this term should be employed when the American made drug is used

added epinephrine solution, this drug is the most easily used and generally efficient anesthetic at present available and is to be unqualifiedly recommended

Local Use—Novocaine produces a slight initial burning and a dilatation of the capillaries when applied to mucous surfaces The anesthesia is long delayed and incomplete For this reason it is less serviceable for use in the eye and the nasopharynx than cocaine In the nose and the pharynx it can be used with fairly good results in 10 per cent solution It acts more slowly than cocaine, is more expensive than quinine and less efficient than either

By Injection—It is only when injected into the tissues that novocaine becomes efficient and satisfactory The more directly it is brought into contact with the sensitive areas it is desired to anesthetize, the better If in addition to the proximity to the sensitive area the influence of pressure can be added, the anesthetization is much expedited So used, anesthesia begins at once Likewise when injected into the substance of a nerve anesthesia is instantaneous When injected in the neighborhood of a nerve usually 15 to 20 minutes are required before full anesthesia is obtained If novocaine is used alone, the effect begins to disappear in about fifteen minutes If used with epinephrine, the anesthesia is prolonged to one to three hours The more directly it is injected into the sensitive area, the longer the duration of the anesthesia

Strength of Solution—Ordinarily a ½ to 1 per cent solution is used The operator will do well to calculate in the beginning the amount of fluid likely to be required In extensive operations the weaker solutions may be used in situations where in smaller operations the stronger solution would be preferred Occasionally in perineural blocking, as about the deep nerves of the skull and face or extremities as in brachial plexus or sacral blocking, some operators recommend a 2 per cent solution Personally I use ½ to 1 per cent solution for all purposes and in all situations Properly used it is wholly efficient, and if no stronger solution is ever made up the accident not unknown when a strong solution was used, instead of a supposedly weaker one, is avoided

Epinephrine is always used in novocaine solutions Manufacturers often incorporate it in tablets with novocaine These are not always stable, and it is best to employ the epinephrine (or adrenalin) solution For ordinary purposes from 5 to 8 drops are added to each ounce of the solution

Preparation of the Solution—Novocaine bears boiling It may be boiled in physiologic salt solution and the epinephrine added after it has cooled to body temperature Most surgeons prepare it in some such manner It has been my practice to proceed in a much simpler manner An ordinary medicine glass and a dropper are sterilized with the instruments A cup of sterile water is provided When the operation is about to begin the nurse drops from 2 to 4 tablets of novocaine of approximately two grains each, out of the bottle onto the table The surgeon drops these into a medicine glass and crushes them with the plunger of the syringe The glass is then filled with water The nurse then brings the adrenalin bottle and the surgeon withdraws the desired amount from the bottle with the sterilized medicine dropper and adds it to the solution After it is thoroughly mixed, the solution is ready for use Boiled water is used and all utensils are boiled, but neither the tablets nor the epinephrine are boiled I have used this simple method for many years without any greater number of infections than after general anesthesia The chief advantage is that the solution is always fresh and the surgeon can vary the solution to meet the immediate demands He knows just what the solution contains If it is prepared beforehand even by competent hands, sterilized and cooled, the solution is always some hours old before it reaches the surgeon I have so often encountered improperly made solutions that I am apprehensive unless I observe the preparation of the solution

The failure to sterilize the novocaine or adrenalin will shock the sensibilities of many, but I have examined these substances in the bacteriologic laboratory repeatedly and pathogenic bacteria were never found I have in the light of these studies and very extensive clinical experience, no hesitancy in using solutions so prepared, anywhere for any purpose

When small amounts are to be used at frequent intervals, during the day, as in dental and dispensary practice, a preserv-

ative may be added to make the solution more stable Fisher advises the addition of thymol because it is in itself a local anesthetic as well as a preservative His formula is as follows

Novocaine	1 5
Sodium Chloride	0 92
Thymol	0 025
Distilled Water	100 0

This makes a 1½ per cent solution of novocaine in normal salt solution to which ⅓ grain thymol has been added The solution bears boiling and epinephrine may be added at the time of use For general use it has the slight objection that it causes more burning when introduced into the skin due to the presence of thymol

Some surgeons use more elaborate solutions There is no objection to them except their complexity Complex solutions are particularly disadvantageous when the operator is compelled to operate at hospitals in which he is not acquainted or in private homes Every added factor in the routine of technic brings an added danger I have tried them all and fail to see any great advantage I have had numerous experiences in the use of solutions the exact preparation of which I had no means of knowing

Method of Use—The important factor in any local anesthetic is the method of use It must be placed in the proper place The proper place is in or about the nerve trunks or about the nerve endings It is the problem of so placing the solution that forms the subject matter of the succeeding chapters

When the solution is injected beneath the skin, that is, into the subcutaneous tissue, the solution must reach the terminal nerve trunks by diffusion and anesthesia is not immediate, but often ten to twenty minutes elapse before anesthesia is complete This problem will be elaborated in the following chapter

Action Upon the Tissues—Novocaine when applied locally causes temporary dilatation of the superficial capillaries When injected into the tissues it produces a fleeting hyperemia associated with a moderate degree of burning When used with epinephrine the preliminary hyperemia does not occur and the burning can be avoided by the injecting of the

fluid slowly When used alone anesthesia lasts from fifteen to twenty minutes When used with adrenalin, anesthesia lasts one to three hours The use of novocaine does not delay wound healing There is no evidence of irritation following its use There is no appreciable exudate and no cellular infiltration Save for a dilatation of the capillaries after the effect of the drug wears off, there is no change in the tissues

Toxicity—Based upon the statements of pharmacologists that novocaine is only one seventh as toxic as cocaine, operators have limited the use to 7 grains for the operation Braun has used double this amount without bad results I believe Harris is correct when he states that 15 grains are a safe maximum As much as 40 grains have been used by Dr R E Farr in breast amputations without injurious effects It is questionable, however, whether such large amounts are ever required

A number of fatal cases have been encountered in the literature which makes it worth while to learn as much as possible about the circumstances of the fatality and the amount of drug employed On the whole the information is inadequate and unsatisfactory Too commonly when no cause of death can be found death is ascribed to the untoward effect of the anesthetic I once had an onlooker drop dead beside the operating table In some of the reported cases the patient was moribund before the anesthetic was injected Such deaths cannot properly be ascribed to the use of the drug

Judging from the report of Emil Mayer[1] it is doubtful whether any fatalities have occurred from procaine Those interested in the toxicology of local anesthetics, particularly the rhinolaryngologists, should study this article, for most of the fatalities come from the use of anesthetics in this region

The symptomatology of intoxication is variable Usually there are convulsive movements of the head and neck with a spasmodic closure of the jaw. The upper part of the body may take part in the convulsion The pupils are dilated and the gaze is fixed The entire body may become convulsed and cyanosis is added Death seems to be the result of respiratory

[1] J A M A. 82 876 1924

paralysis Some patients faint during the early part of the operation This is not attended by convulsive movements but by pallor and perspiration Many years ago I had a large man of 50 faint from a few drops of cocaine A few days later he fainted following the injection of a like amount of distilled water One evidently cannot ascribe to the toxicity of the drug everything that follows its injection

In many thousands of operations including everything in major and minor surgery I have seen no more serious signs of intoxication than loss of consciousness and fixation of the jaws with slight twitching of the face This has occurred altogether two or three times, all in operations about the throat or mouth

Cocaine

Because of the dangers in the use of cocaine by injection its use for this purpose is no longer justified since we now have equally efficient and safer drugs As a topical anesthetic it is still extensively used because there is no efficient substitute and because it is less dangerous when used in this manner Salmon[2] has sought to establish experimentally a ratio between cocaine and other drugs when used on mucous surfaces If cocaine in ½ per cent solution is taken as a standard of measurement, then Beta eucaine in a 1 per cent solution is half as efficient, quinine urea, tropocaine and alypin in 2 per cent solution are one fourth as efficient, in 8 per cent solution apothesin is one eighth as efficient and novocaine is one sixth as efficient in a 10 per cent solution I believe clinical experience will confirm these conclusions

All mucous surfaces may be anesthetized by the application of cocaine For operations about the eye and the nose this means of anesthesia is almost universally employed, and because of the small amount required in these regions cocaine is comparatively safe It is dangerous when used about the genitourinary organs and rectum because the extensive surfaces require more of the solution Numerous fatalities have followed its use in these regions and few operators at the present time care to risk its dangers

[2] J A M A 70 216 1918

Strength of Solution—For local application solutions from 2 to 5 per cent are most commonly used Some laryngologists employ a 10 per cent or even a 20 per cent solution and some use the powdered drug directly on the surface to be attacked Generally speaking the weaker solutions are efficient if applied persistently and carefully Once the patient's tolerance has been tested by the use of weaker solutions, the stronger are not so objectionable but the strong solutions should not be used on untried patients

Usually epinephrine is added to the solution when mucous surfaces are to be operated on, though cocaine is itself somewhat vasoconstricting The usual amount is about 8 minims to the ounce of the solution

Methods of Use—The essential factor is, of course, to apply the drug at the point where the operation is to be performed When the surface is wide and complex the spray serves to secure a moderate degree of anesthesia over the whole surface This does not secure an anesthesia complete enough, however, for the performance of operations on the underlying tissues For this cotton pledgets saturated with solutions of the drug must be applied directly to the field of the operation Accuracy of application is more important than the strength of the solution Mucus is exuded and tends to prevent further absorption of the drug It is necessary, therefore to change the cotton pledgets from time to time At least ten minutes are required to secure complete anesthesia

Toxicity—The symptoms of cocaine poisoning manifest themselves without warning They are pallor or slight cyanosis, often *with restlessness and sometimes with a sense of impending disaster* Less common is a chilly feeling dryness of the pharynx, inability to swallow or spasm of the glottis, small and rapid pulse, sometimes vomiting More rarely sudden collapse is the first symptom These conditions may extend into unconsciousness

It is not always recognized that symptoms of cocaine poisoning may continue for a considerable time, even days Among the symptoms that may be mentioned are persistent dizziness, insomnia, irritability, increased reflexes, disturbed gait with or without muscle spasms, dysphasia and in rare instances, accord

ing to Lewin, a rise of temperature These symptoms may follow the use of exceedingly small doses even to 0 0005 gm Tobias and Kroner report a chronic poisoning from 1 c c of a 1 per cent solution injected into the gums The symptoms spastic paraplegia, increased patellar reflexes, ankle clonus, insomnia and rise of temperature persisted two weeks with ultimate recovery

In some instances fainting may follow the sight of blood, or the thought of the operation may cause the patient to become pale, which may excite in the mind of the operator the fear of cocaine intoxication To distinguish between the two conditions is not always easy In simple syncope the subject's condition rarely assumes any other form than pallor, limpness and loss of consciousness If cyanosis, dyspnea and a sense of fear or great excitement appear it is safest to assume that cocaine intoxication has taken place

The treatment of cocaine poisoning is principally prophylactic Not much can be done after symptoms appear The patient should, of course, be laid down, if not already recumbent, the clothing loosened and the respiratory action freed as much as possible from impediment

Of the 43 cases of death from local anesthesia reported on by Emil Mayer (l c), 26 were due to cocaine Cardiac massage and artificial respiration with possible intracardiac injection of 2 c c of 1 10,000 of epinephrine are offered as measures to combat the toxic effects

Though novocaine and cocaine, by all odds, stand in first place in the production of local anesthesia, a considerable number of other drugs have been introduced from time to time It seems worth while to list them, since, should the first mentioned not be available, satisfactory anesthesia can be obtained by any of them

Quinine and Urea Hydrochloride—This drug has to its advantage absolute safety in any amount and the long duration of the anesthesia The disadvantages are the burning pain at the beginning of injection and the induration due to formation of a fibrinous exudate I formerly used it in anal operations be

cause it controlled the after pain It is now chiefly used in this clinic for the control of pain in neuralgias It is used in a 1 per cent solution

Diothane is the latest candidate for favor as a local anesthetic I have studied its effects on tissues in my own leg and in rabbits' ears It has certain distinct advantages not possessed by novocaine, notably the prolonged duration of the anesthesia and its efficiency when applied topically

Action on the Tissues —Injected into one's own skin diothane causes no burning but only slight pain from expansion of tissue The degree of this is dependent on the size of the needle and the skill with which the injection is made When the wheal is formed, the anesthesia is almost immediate and the anesthesia does not completely disappear for four days There is no zone of hyperanesthesia when it is subsiding, as one finds is the case in the use of quinine and urea hydrochloride anesthesia When used with adrenalin there are some peripheral hyperemia and a sense of soreness

When injected into a rabbit's ear, after three days the skin in the area injected has a perceptible edematous feel A tissue section of this area shows an amorphous edema with some perivascular round cell infiltration The formation of granular fibrin as observed after the use of quinine is absent The duration of the anesthesia is parallel with the persistence of this edema, which disappears in a week without leaving a trace and is therefore not objectionable

The anesthesia lasts several days Consequently it has some merit in operations attended by much after pain, notably about the anus It is employed in 1 per cent solutions The chief disadvantage of this drug is that adrenalin cannot be used with it For the control of after pain following hemorrhoidectomy it must be injected into the base of the hemorrhoid at the point where it is to be severed just as one would use novocaine for the same purpose

Nupercaine is a recent candidate for favor The chief claim for it is that the duration of anesthesia is greater than that of procaine Keyes and McLellan[3] have presented the most important communications in American literature

[3] Am J Surg 9 1 1930 J A M A 96 2086 1931

It is variously estimated as about twenty times more toxic than cocaine The above authors report eleven deaths

The uncertainties of the drug seem such that its use should be confined to those who are experienced in the use of local anesthetics and their dangers That it will become a rival of procaine in general surgery seems unlikely

Other Drugs Used

Stovaine has been used chiefly in spinal anesthesia, but it has also been used in infiltration anesthesia It is less toxic and less efficient than cocaine, but is said to give better results in inflamed tissue In many cases it is reported to work well and in others without evident reason results are not satisfactory One is justified in regarding such statements as reflecting more on the technic of the surgeon than on the efficiency of the drug Stovaine may be used in the same way as novocaine It has been added to alcohol for injection into neuralgic nerves

Apothesin has been used considerably in this country during the past few years and is well thought of by many surgeons I made a study of its action in my own skin some years ago and found it more irritating than novocaine and its effect lasted longer It may be used in any condition in which novocaine is used I have used it to some extent and found it satisfactory, but I found no reason to change from long tried drugs

Tutocaine is a new candidate for favor as a local anesthetic It was placed before the profession by Bayer early in 1924 Lawen believes it stands midway between cocaine and novocaine in toxicity while Chetwood and Cooney, and others believe it has but half the toxicity of novocaine Tschebull saw one death and eleven unfavorable manifestations in 720 cases He regards 200 c c of ½ per cent solution as the safe limit Schwartz records a death from its use in the urethra

It is ordinarily used in ½ of 1 per cent solution for infiltration anesthesia Sidener regards it as useful in the urethra and bladder when 8 to 10 c c of a ½ per cent solution is used Fessler thinks it is as efficient as cocaine Barth finds it useful in laryngeal work in ½ per cent solution

Tschebull notes the symptoms of toxicity as follows nausea, dizziness, followed by unconsciousness with cyanosis and

dyspnea Tonic clonic cramps develop The pupils dilate widely and do not react to light A frequent untoward symptom is an uncontrollable loquacity Being a new drug, this is to be expected and, as most new drugs, may affect both parties in the experiment

The review of the literature leaves one with the impression that this drug may prove to be as efficient as cocaine as a topical anesthetic and less dangerous There is little to indicate that it will be a serious rival of novocaine for general use

Beta eucaine may be used in quantities up to three grains, it is said, and as much as 15 grains have been used without alarming effects It may be used in the same strength as cocaine in Schleich solution, or in 1 per cent solution for infiltration For local application in the eye or the nose, 2 per cent solutions are used

Tropacocaine has been used in similar strengths, and it is said to be safe up to five grains Among other drugs which have been used may be mentioned *anesthesine*, *subcutin*, and *alypin* Since the discovery of novocaine these drugs are seldom employed

The Use of Epinephrine as an Aid in Local Anesthesia

Perhaps more credit is due to Braun than to any one else for having discovered the usefulness of epinephrine as an adjunct to anesthetic solutions By means of this drug he hoped to lessen the rate of absorption of cocaine and render it thus at once safer and more efficient Its chief value perhaps is in lessening hemorrhage because it admits of a more exact technic It is possible to see vessels before they are cut so that they may be double *clamped and ligated* This is particularly advantageous in such operations as thyroidectomies where exact hemostasis is imperative In this way the danger of after hemorrhage, sometimes attributed to the action of epinephrine, is avoided It aids in this by constricting the capillaries so that the larger vessels can be seen before they are cut In operations where exact technic is impossible, after hemorrhage is more liable to follow than when general anesthesia is used This occurs because the drug constricts the small vessels so that immediately after operation the field appears free from hemorrhage After the action of the

drug ceases the vessels dilate, and hemorrhage begins This is particularly true following tonsillectomies It is necessary in such regions to reduce the amount of adrenalin to a minimum

The addition of adrenalin to the anesthetic solution increases the duration of the anesthetic greatly Novocaine alone, as has already been mentioned, produces anesthesia lasting but fifteen to twenty minutes, while with the addition of adrenalin the anesthesia lasts for one and one half to three hours

Usually from 5 to 10 minims of the 1 1000 solution of epinephrine is used to an ounce of the anesthetic solution When huge amounts of the solution are used the proportionate amount must be reduced Not more than 20 minims should be used during any operation Save in toxic goiters the maximum amount above noted will produce not more than slight agitation and quickening of the pulse Cardiac spasm, dyspnea and even more alarming signs have been reported but such reports lack convincing detail Untoward results are more liable to follow the use of decomposed solutions A solution containing epinephrine that has become pinkish should be used only for the most minor operations Epinephrine which has been uncorked for a considerable time sometimes forms granular precipitates This likely is inert and should not be used

The synthetic epinephrine should be of uniform strength, but in my experience its action is less dependable than that of the natural substance This is true as to both the vascular constriction and the prolongation of the anesthetic It has been discovered that the natural epinephrine is spectroscopically levorotary while the synthetic is dextrorotary

Combined Local and General Anesthesia

Generally speaking, the combination of general and local anesthesia is a confession of lack of skill or lack of judgment Certain cranial operations can be satisfactorily done under local anesthesia but at some point a general anesthesia is required Formerly in doing major abdominal operations when adhesions were encountered general anesthesia had to be resorted to The error was of course in starting with local anesthesia The use of spinal anesthesia has now done away with these cases

The objection to following or supplementing local anesthesia with general anesthesia is that when major operations are done a preliminary hypnotic is given Usually the patient is placed in an agitated state before the general anesthetic is started This makes a combination of conditions highly prejudicial to a safe general anesthesia

Generally speaking, if a general anesthetic is mandatory gas is preferable to ether Unfortunately usually surgeons who get themselves in this pickle do not have gas anesthesia available Therefore, as a general rule, unless the surgeon knows he can perform the operation successfully under local anesthesia, he *had better begin with a spinal or a general anesthesia* The most certain way to fail with local anesthesia is to tell the patient that if local fails a general will be given In such cases it will most surely be needed

Combination of Local Anesthesia with Narcotics

A hypnotic or a narcotic is generally used as a preliminary to local anesthesia in all major cases, notably in thyroidectomies, block dissections of the neck, jaw operations and the like If the patient is highly nervous and apprehensive, it is well to give sodium bromide, 20 grains three times a day for several days preceding the operation The evening before the operation 4 grains of amytal are given Two hours before the operation 3 grains of the same drug are given In aged, young or feeble patients these doses are reduced accordingly

These preliminary drugs quiet the patient, yet he is not so stuporous as to be indifferent to his surroundings nor to dull his respiratory reflexes to an undesirable degree, a very important matter in major operations about the mouth and jaws

In operations of lesser magnitude, such as the removal of tumors, hernias or rectal operations, one fourth of a grain of morphine at least an hour before operation is given The same dosage is given as a preliminary to nerve injections for neural gias

It must be emphasized that morphine must be given at least an hour before the operation is begun Otherwise it may but heighten the patient's apprehension

CHAPTER II

TECHNIC OF ADMINISTRATION

Suitable instruments kept in good condition are essential to success in operations under local anesthesia Dull knives cause pressure on distant nerves and give the patient discomfort at the outset when he is most open to suggestions of doubt Dull scissors pinch but do not cut Badly working forceps pull unnecessarily upon the tissues Above all, a dull and rusty needle and a leaking syringe will defeat the efforts of the most expert operator

Apparatus

The syringe and needle are the essential implements in local anesthesia These must be well made and kept in perfect condition and each must be adapted to its purpose if the procedure is to progress smoothly Apparatus used in local anesthesia should be used for this purpose alone It is not necessary to purchase especially made instruments They are more expensive and more difficult to replace and have no real advantages

The Needles

The needles are the most important part of the working equipment They must be sharp, free from rust and long enough to reach the field it is desired to anesthetize The beginner is likely to underestimate the depth of the sensitive tissue and use too short a needle The needle should be long enough so that it is not necessary to insert it to the hilt

The size of the needle is important It should be as small as possible, for the smaller the needle the less injury to the tissues and consequently the less pain its insertion causes (Fig 1 *A* and *B*) I use for the endermic injection a needle of 25 gauge and ¾ inch in length For deeper injections a gauge of 22 and a length of 2¼ to 4 inches is used For deep injections a needle of 19 gauge and 5 inches in length is required These long needles are needed only in deep parauterine injections, injections in thick abdominal walls, paravertebral injections, sciatic nerve blocking, and the like

Needles can be used repeatedly if they are cleaned in water and then in alcohol and preferably finally in ether each time after an operation is finished The wire stylet should always be inserted after the needle is cleaned The needle point should be sharpened from time to time on a fine oil stone and the shaft polished with fine emery Needles are not expensive and the

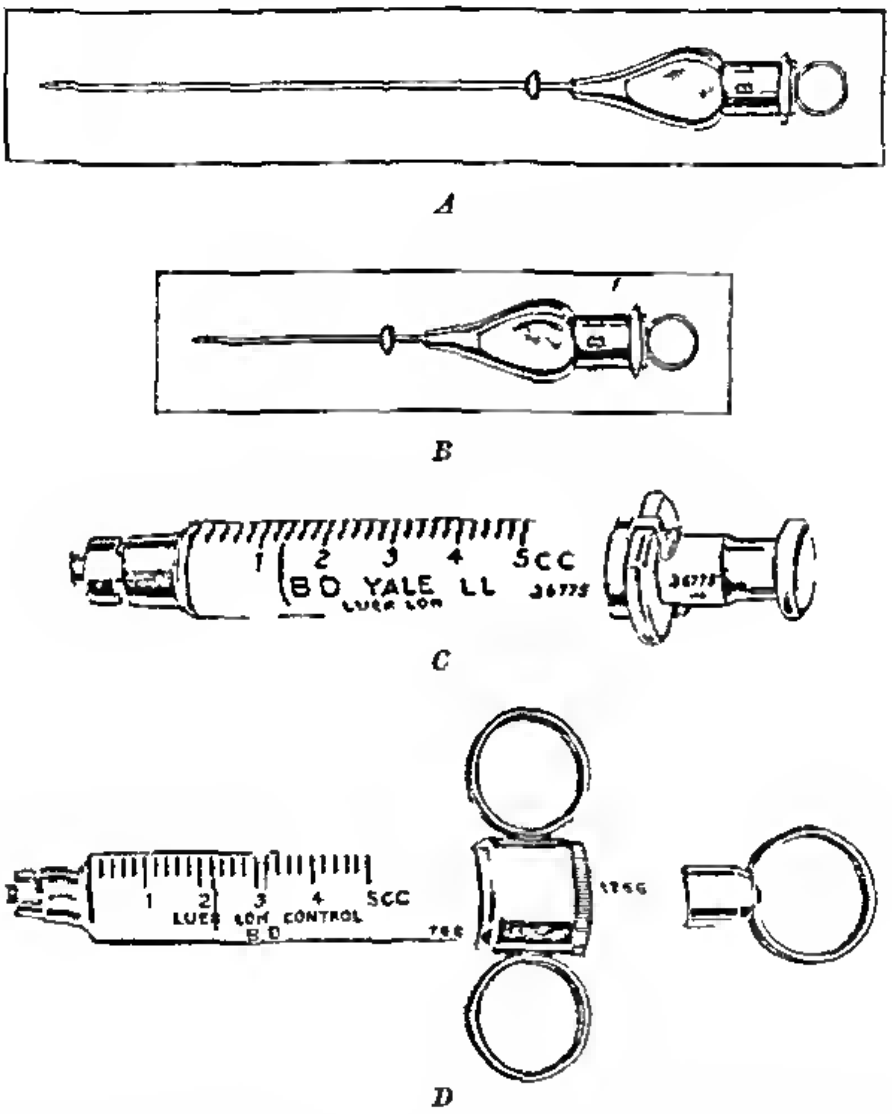

Fig 1—A Two inch 22 gauge needle B Three fourths inch 20 gauge needle C Yale Luer Lok syringe *D* Luer Lok control syringe (Courtesy Becton, Dickinson & Co)

fine ones used for the initial injection should be discarded as soon as they become defective The large needles are more expensive, but are more easily cared for, and since they are passed through the tissues already anesthetized, their perfect condition is not so essential

Some operators use a needle with an obtuse point or one carrying a stylus. Such needles are convenient in spinal and sacral anesthesia and injections about the base of the skull, about large vessels, etc. However, I no longer employ them because they complicate the armamentarium and with care ordinary needles can be used.

The breaking of needles during an operation is an annoyance. They usually break at the point of junction of the shaft and the nub which takes the syringe. If a needle is sufficiently long so that its full length is not needed, if it does break at the point indicated, it is easily removed. Needles that break in the shaft are always those which have rusted in the lumen, thus materially weakening them. One can tell by the spring of the needle when bent on itself whether or not it has become weakened. In spinal work one must be sure that he has a good needle. Even if it breaks below the skin, it is easily removed after the incision is made. If one takes such little accidents as a part of the day's work, the annoyance is less than the bother of a lot of extra apparatus. Many operators think differently and use styleted needles in a field where a broken needle is particularly annoying, as in sacral and spinal anesthesia. However, such a needle is quite as liable to break as an ordinary needle.

The Syringe

We use all glass syringes. With care the tip which receives the needle is seldom broken. They are much cheaper than syringes with metal mountings.

Many operators prefer syringes with metal tips so fashioned that by making a half turn of the needle it is locked firmly in place (Fig. 1-*C*). This prevents the needle from slipping off at inopportune moments and squirting fluid into the face of operator and assistants. When very tense tissues are to be injected, rings for the fingers give a much firmer hold (Fig. 1-*D*). Such accessory holds give too much power when soft tissues are being injected and result in a too rapid injection of the fluid. I prefer a 5 c.c. syringe. Syringes of larger capacity are more awkward to handle and result in a needlessly large amount of fluid being used. I have never yet seen an operator who used a large syringe do even a passably correct

job A minimum amount of fluid properly placed should always be the aim of the operator This can be achieved only with the use of relatively small delicate instruments

The smoothness of the working of the piston is the most important part of the armamentarium If the piston does not work smoothly within the barrel, fluid will be expelled unequally and cause pain by the sudden dilatation of the tissues The commonest fault of syringes is that the barrel differs in caliber in different portions In the narrow portions the piston works with difficulty, while in the wider portions it permits the fluid to leak back Very finely made syringes require care They must be cleaned in water and alcohol and carefully dried They are best stored with the piston and barrel separated by a layer of gauze If a deposit forms either on the piston or within the barrel during the sterilizing process, this must be rubbed off Often a fine piece of lint may lodge between the piston and barrel and interfere with the proper operation of the syringe

Some operators use more complicated apparatus Usually self acting syringes encourage the use of an excessive amount of the anesthetic solution Many operators use syringes and needles which have an arrangement which locks the needle to the syringe by a half turn This prevents the needle from slipping off and squirting the anesthetic solution in the operator's face This little accident is quite annoying when injecting certain parts of the body Such apparatus is but little more expensive and adds to the convenience of the operator Syringes with nubs placed excentric to the center of the syringe are altogether unnecessary refinements The needles are sufficiently pliable to make it possible to insert them in any direction desired

The greater the diameter of the barrel, the greater the pressure required to force the fluid out of the needle The difficulty of gentle infiltration increases in proportion to the diameter of the piston For this reason large syringes can be used only for the edematization of the loose areolar and muscular tissues

All my ordinary work is done with a 5 c c syringe This size is convenient to use and six fillings dispose of an ounce of the anesthetic solution, an amount sufficient for most operations For certain purposes specially designed syringes are convenient

In the injection of dense tissues, as in dental work, strong metal syringes with narrow pistons and a large handle enable the operator to secure great pressure within the tissues Such syringes should have the needle fastened on by a screw thread or other fastener In tonsil work, where the amount of fluid required is small, a syringe of 2 or 3 c c capacity is desirable They must be armed with an extension so that the tonsil can be conveniently reached

Special needles have been devised for special purposes Curved needles for injecting about the base of tumors are superfluous They are expensive, not easy to obtain, and are easily broken The angled needles for use in dental operations are convenient Appliances for marking the depth to which the needle is passed or needles marked with a scale are unnecessary A bit of cork through which the needle is passed serves quite as well

Container for the Anesthetic Solution

Any receptacle that can be sterilized by boiling is satisfactory We use in this hospital an ordinary two ounce medicine glass Those using larger amounts of fluid prefer containers of greater capacity A granite iron cup of 8 or 12 ounce capacity is usually selected

Sterilization of the Apparatus

The syringes, needles and containers for the solution, properly protected, are sterilized with the other instruments Plain water is used If the water ordinarily used in the sterilizer is very hard, distilled water is preferable because it avoids the deposits which form in the syringe when hard water is used

General Preparation of the Patient

In carrying out operations under local anesthesia the most important factor is confidence on the part of the operator based on experience, that the result will be satisfactory If the operator is apprehensive, the patient is sure to imbibe his lack of confidence Nothing will more certainly make for failure than to have a general anesthetic in readiness and to assure the patient that he will be given ether if the local anesthetic fails

Stopping the patient's ears with cotton or covering his eyes, unless required by the nature of the operation, serve only to disturb him Besides the expression of the patient's face is the operator's gauge of success in his anesthesia

It is desirable that any patient about to undergo an operation should have his mental and physical equipoise disturbed as lit tle as possible This is doubly important if the operation is to be under local anesthesia Unless some special indication exists no great departure from normal living is required A full bath, a restful night's sleep and a normal bowel movement are all the general preparation that is required A patient who is confined to bed for a period of days should make his dietary harmonize with the enforced inactivity I usually permit the patient a cup of coffee the morning of the operation If a hypnotic is to be given the stomach had best remain empty of food Purgation and starvation are particularly to be avoided because they in spire apprehension and do no real good If the patient is accus tomed to enjoy an after breakfast cigar, it should not be denied him

Special Preparation

Candidates for operation under local anesthesia should be shown special consideration during the preliminary preparation Care must be taken that the manipulations do not cause pain Immediately before the operation the field to be attacked is painted with Ti Iodine, either full strength or diluted with an equal quantity of alcohol Mercurochrome is now generally em ployed It at least looks impressive In operations about the scrotum or anus this cannot be employed, and soap and water must be depended upon or picric acid solution may be used in addition The use of iodine has proved reliable and where the nature of the skin permits, its use is more pleasant to the pa tient than the vigorous scrubbing with soap and water Soap must be removed with water, otherwise it makes the skin slip pery and renders the necessary manipulation in skin infiltration more difficult Simple cleansing with clear water lessens this inconvenience but does not entirely remove it Where alcohol can be employed it will remove the soap entirely

The Preliminary Infiltration

When the injection of the anesthetic solution is about to be gin, the surgeon should assure himself that the patient is in a comfortable position A strained position may be more trying than the operation, as for instance, holding the legs in the lith otomy position in rectal work Pillows under the head and in the small of the back may aid in making the patient comfort able and assist in gaining his cooperation He may be allowed to see the preparation of the instruments in order that he may become familiar with the sound of their manipulation He may be engaged in conversation about some matter of common in terest, or the operator may relate to his assistant the success of some similar operation The advantage of faith in the success of the operation is incalculable, and the operator should spare no pains in acquiring the confidence of the patient The oper ator should sit down, if possible, both to prevent fatigue and to permit more delicate and accurate manipulations

Before the initial injection is made, the patient should be told that the first prick of the needle will cause about as much pain as the giving of an ordinary hypodermic injection One of my patients estimated the pain as about "two mosquito power" I have used this expression with advantage to the mental poise and comfort of other patients This forewarning prepares him for the slight pain It is remarkable how far minute detail goes toward gaining the confidence of the patient and establishing his faith in the success of the procedure If the initial prick causes the patient to scream with pain, the operator has an indi cation of the state of his mind, and renewed efforts must be made to gain his cooperation

Methods of Injection—Before beginning the injection the operator must plan his operation in detail The neural anatomy must be recalled in his mind's eye, and it must be decided by what steps the various sensitive tissues may be anesthetized The order in which the various steps are carried out depends on the anesthetic used, the nature of the operation and the char acter of the patient

A number of methods are employed, depending on the size and accessibility of the nerves involved in the operation In ter

minal nerve endings the anesthetic fluid can most advantageously be deposited in the tissue in which the nerve endings lie, namely, the papillary layer of the skin This method is called *endermic infiltration* In large nerves the solution may be injected directly into the nerve sheaths This is called *nerve blocking* In large nerves this can be done without exposing the nerves, as in case of sciatic, brachial plexus, etc In smaller ones, as in ilio inguinal, radial, ulnar, etc, it is necessary first to expose the nerve In most instances the infiltration is made in the region of the nerve and dependence is placed on diffusion of the fluid to reach the nerve fibers This is called *perineural infiltration* This method is depended upon, for instance, in hernia, thyroid operations, etc When the operator has no definite notion as to the location of the nerve supply the tissues are infiltrated diffusely This may be called *edematization* These several methods may be described in detail

Endermic Injection

Endermic injection seeks to anesthetize the end organs in the skin Anesthesia in this method is dependent in part on pressure within the tissues, but the chief action is a direct chemical one upon the nerve endings The fluid should, therefore, be brought as nearly as possible in direct contact with the nerve endings, that is, in the papillary layer of the derma

In beginning the injection, one picks up the skin between the thumb and the forefinger of the left hand and makes a firm pressure (Fig 2 *A*) This produces a local anemia rendering the skin less sensitive to the initial prick of the needle As soon as the point of the needle has entered the epidermis, slight pressure on the piston forces out the solution which, displacing the blood in the capillaries, causes a blanching of the skin (Fig 2 *B*) In this way the fluid, as it escapes from the needle, comes in contact with the nerve endings in the papillary layer of the skin (Fig 3) Anesthesia at once follows the blanching If the fluid is introduced rapidly, the stretching of the tissues causes pain before the anesthetic effect has had time to manifest itself If the needle penetrates too deeply, the fluid escapes into the loose subcutaneous tissue and edema is produced, but the skin is un

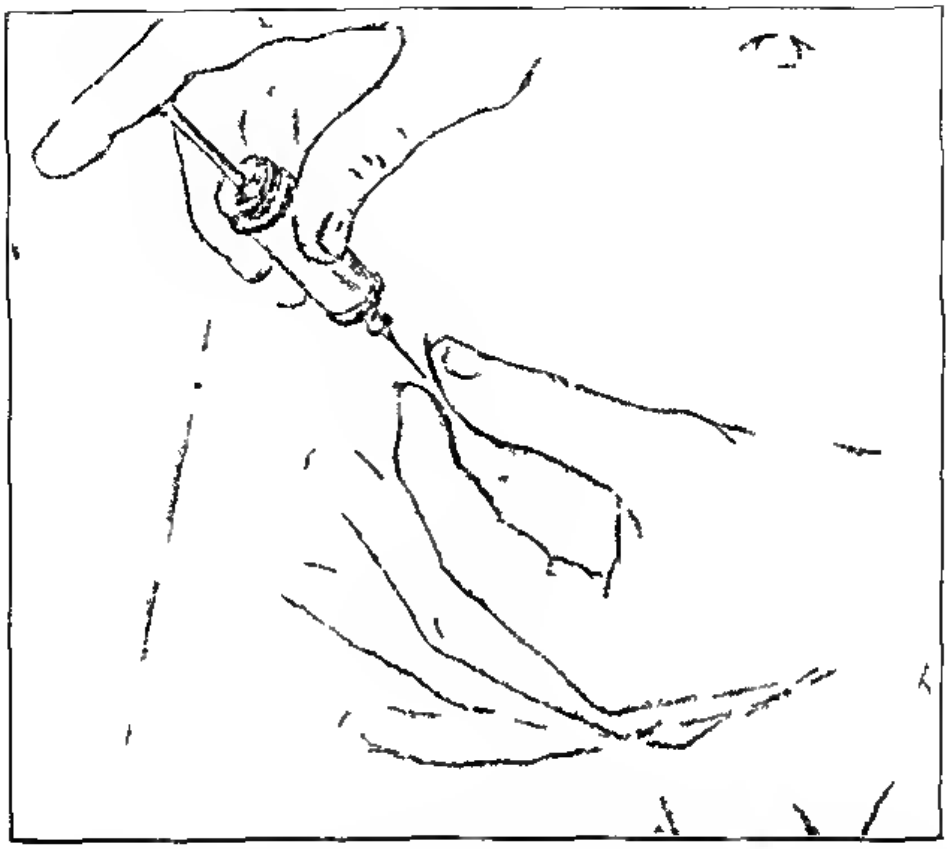

Fig 2 *A*.—The proper method of picking up a fold of skin in beginning infiltration Pressure with the thumb and finger is made until the skin is anemic

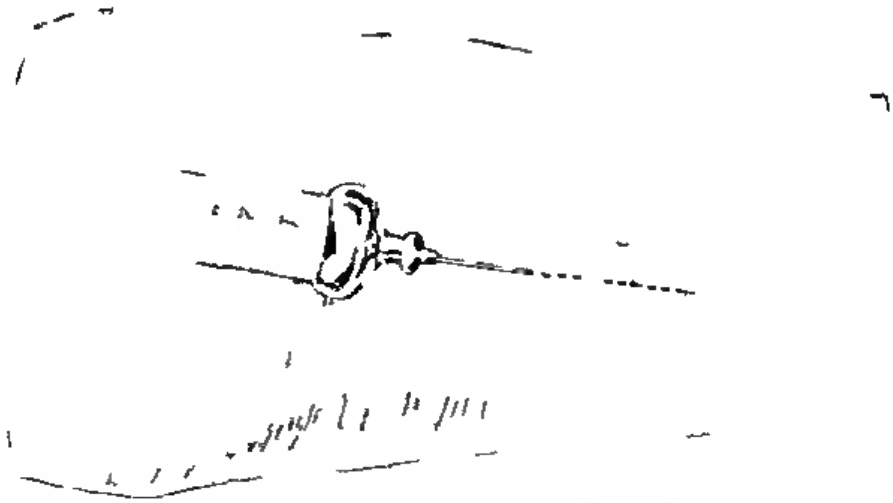

Fig 2 *B*.—Showing a wheal produced by endermic injection The rings indicate the location of subsequent wheals as the needle is pushed forward

changed in color In this case several minutes will elapse before the skin loses its sensibility Less skill is required to introduce the fluid subdermically, but the results are less satisfactory

Blanching from the first endermic injection having appeared the needle should now be pushed forward nearly to the opposite border of the blanched area and the piston again pressed A blanched area is produced extending for a distance in advance of the needle (Fig 2) When the needle will reach no farther, it is withdrawn and introduced again near the edge of the blanched area and the injection proceeds as before until the entire line of the proposed incision has been injected

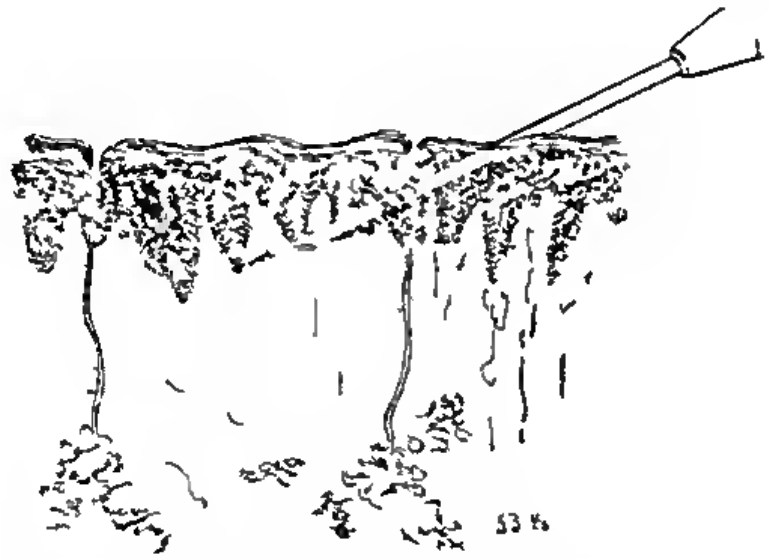

Fig 3—Endermic infiltration The needle penetrates the papillary layer of the skin and follows along this plane

If the skin only is to be incised, it may be done at once after the endermic infiltration is finished Care should be taken to note the line of infiltration, for if properly done, the blanching has disappeared before the infiltration has all been made It has been proposed that the line of injection be marked by drawing silver nitrate or tincture of iodine along it provided the latter drug has not been used to sterilize the field of operation This is time consuming and unnecessary Although the blanching may have disappeared the general direction of the infiltrated line can be retained in the mind's eye and this aided by the palpable edema of the skin will enable the operator to follow accurately the infiltrated line

The advantages of this method of anesthetizing the skin are that it requires a minimum amount of fluid and that anesthesia appears as soon as the infiltration is complete The surgeon's skill in the use of local anesthesia is better shown in this initial step than in any other If the injection is properly done, the initial prick alone causes pain The width of the line to be infiltrated may be varied by the amount of fluid injected, the more fluid is forced out at each point the wider the area infiltrated by the fluid

Subdermic Infiltration

When the skin or mucous membrane is very thin endermic infiltration may not be possible The solution must then be injected immediately beneath the surface (Fig 4) This applies not only to thin skin, as in circumcision, but also to fascia and

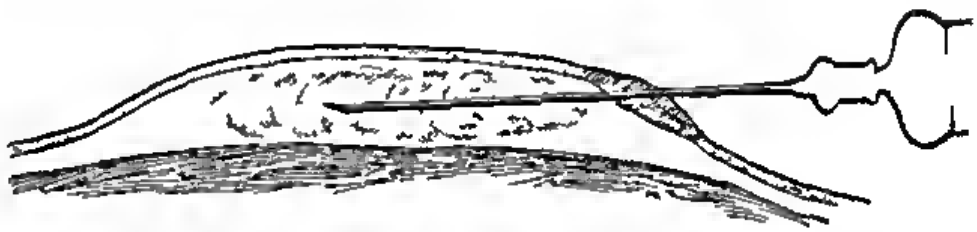

Fig 4—Subdermic infiltration The fluid is injected into the loose tissue immediately beneath the skin

peritoneum Most operators employ this method in skin infiltrations in general, but it not only requires more anesthetic solution but some time must elapse before the overlying skin is anesthetized

Nerve Blocking

Properly speaking, this term should be used only when nerves are directly infiltrated This method is suited to such fields as are supplied by a limited number of nerves of definite location Usually the nerve is not directly injected, but the fluid is deposited about it so that the nerve becomes infiltrated by diffusion When a nerve supplying a region can be reached, it may be anesthetized by injecting directly into the nerve sheath In certain large nerves this may be done without exposing it, but in most cases it is necessary to isolate the nerve trunk and to fix it carefully with the tissue forceps (Fig 5) before attempting

to thrust the needle into it. The forceps here illustrated (Fig. 5) enables one to pick up the nerve with the greatest gentleness. By grasping the nerve in the hollow portion of the forceps (Fig. 5), and passing the needle within the grasp, the forceps form a constriction about the needle. The fluid injected distends the nerve sheath like a sausage and may be made to traverse some inches of the sheath. The entire area supplied by the nerve may then be operated upon without fear of producing pain. This is the ideal method of anesthetization when the trunk of the nerve supplying the entire region to be operated upon is accessible. Unfortunately this method is applicable only when

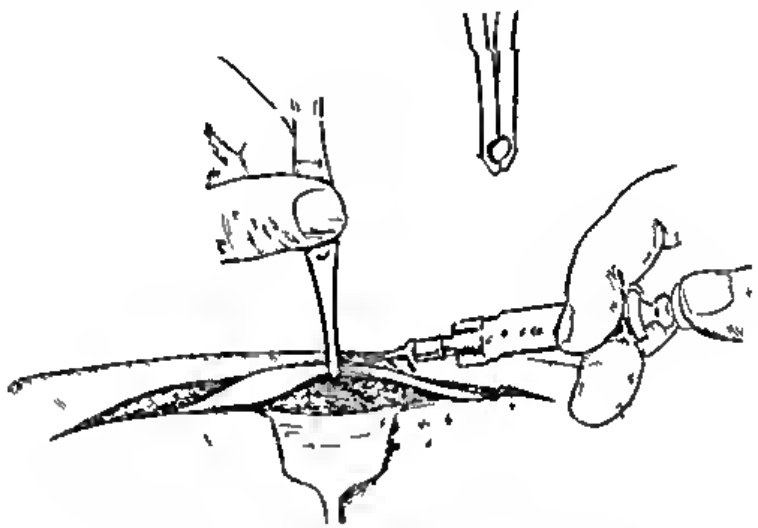

Fig. 5.—Method of picking up a nerve for endoneural injection. In the insert the hollow tip of forceps is shown natural size.

the nerve trunks large enough to be directly injected are exposed during the course of the operation or are easily reached by a preliminary incision.

Perineural Injection

In most cases the operator must depend upon the accuracy of his anatomic knowledge to inject the fluid into a deeply lying nerve trunk or at least into its immediate vicinity. This is illustrated by regions such as the foramen ovale, the inferior maxillary canal, and the intercostal and abdominal nerves. If the nerve is directly injected, anesthesia takes place instantly. In these deeply lying nerves direct injection is not often possible

unless their locations are fixed by reason of their exit from some foramen or notch Ordinarily the best the surgeon can do is to place the solution as near the nerve as possible This is true in operations for hernias and in thyroidectomy The fluid then reaches the nerves by diffusion

The more recent marked advances in local technic have been in the direction of blocking deep nerves and have made possible many major operations which heretofore had been done only under general anesthesia This is true notably of operations upon the jaws

The term "nerve blocking" is often applied to infiltrations in the skin about the field of operation whereby an ellipse or a quadrangle is described about the field to be operated on This is a hit or miss method and is more correctly called diffuse infiltration or edematization Diffusion must be depended on to reach the nerves

Edematization (Schleich's Method)

The distention of the tissues with fluid was introduced by Schleich in order to secure anesthesia from solutions of cocaine too weak to act by infiltration The fluid is injected into the loose tissue irrespective of the position of the nerves The weak solutions were used because stronger ones were dangerous The method is, therefore, a makeshift to overcome the dangers of the drug employed It was first used with cocaine solutions and is described in connection with that drug

The large amounts of anesthetic solution used by many operators is really anesthesia by edematization The use, for instance, of 3 or 4 ounces in an operation for inguinal hernia is nothing less than edematization When novocaine solutions are used it is done, not because of fear of toxicity of the drug, but to make sure no sensitive area is missed

The Sequence of Endermic Infiltration and Nerve-Blocking

Generally two or more of these methods are combined in one operation Nearly always endermic infiltration is employed for the skin and nerve blocking in some of its forms or edematization is added to anesthetize the deeper tissues Which of these shall be done first is a matter of election

Two general plans may be described The method employed almost universally in my own work and the one described in these pages seeks to anesthetize the skin first After the line of skin infiltration has been made the deeper tissues are infiltrated by passing the needle in the line previously anesthetized This method has the advantage that only the initial prick is perceived by the patient while all other punctures are made in anesthetized skin It has the disadvantage that the operator before the injection is begun must determine the direction and extent of the operation This is the most delicate method, and I believe, is the one best adapted to the sensitive nervous American

The other method is the one generally employed by German surgeons and those Americans who have followed the German lead This method seeks to reach the chief nerve trunk as the first act in the operation This necessitates the plunging of needles of sufficient length deeply into the tissue Two or more of these punctures are necessary After the deep infiltration is made the skin is infiltrated This method has the advantage that niceties of planning and technic are not demanded and that the solution is brought at once in contact with the chief nerve supply of the part The chief disadvantage lies in that several unanesthetized points must be punctured with a relatively heavy needle and the needle must be passed for some depth into the tissue Both these acts are more or less disturbing to the patient in the earlier stages of the operation before his full confidence is gained In addition a wait of some minutes is required before anesthesia is complete When the skin is first anesthetized by endermic infiltration and then the deeper parts are infiltrated, one can begin the operation as soon as the deeper injections have been completed By the time the incision is made and the superficial vessels are ligated the deeper tissues will have become anesthetized

CHAPTER III

MINOR OPERATIONS

Those conditions which may be encountered anywhere in the body may be discussed here The detailed variations in technic required in the several regions are slight and unimportant and will suggest themselves to the operator In many locations the choice of an anesthetic is optional Many operations of a minor sort are commonly done under local anesthesia chiefly as an accommodation to the patient This includes opening of a great variety of abscesses the removal of foreign bodies repair of wounds the removal of tumors and the like

The Opening of Abscesses

The management of acute infections requires as much judgment as any disease that comes to the surgeon Save the minor superficially located ones they are little suited for operation under local anesthesia except for the expert

Localized superficial abscesses are easily anesthetized by freezing This agent is particularly desirable because the injection of an anesthetic is painful no matter how skillfully done This is particularly true of boils just coming to a head If infiltration anesthetic is to be used the injection should be made about the inflamed tissue in the unaffected skin and not directly into it If the nerves are blocked in the unaffected tissue it can then be attacked without causing pain If the abscess is ripe the stage of hypersensitiveness has passed and a line may be infiltrated over its summit by beginning at the border in or near the normal skin If the abscess is on an extremity the nerves supplying the part may be blocked in their course For instance, in case of a felon the nerve supplying the digit may be blocked at some distance from the infected area Novocaine acts more readily but quinine may be used The latter has the advantage of saving after pain The skin over a deep seated abscess may be entirely unaffected and can be anesthetized in a straight line directly over the lesion in the usual

manner Suppuration of cervical or inguinal lymph glands usually comes under this category In deeply seated abscesses it may be desirable to block the nerves leading to the deeper tissues In the neck the superficial muscles can be infiltrated so that the deeper situated tissues may be separated by blunt dissection In case of renal or appendiceal abscess, the parietes are infiltrated as for any other operation, here it is well to block the nerves between the spine and the site of the proposed drainage

In making the infiltration in such cases it is necessary to keep the needle entirely away from the infected area, otherwise the needle may transport infection from the abscess to the surrounding uninfected areas

In extensive infections, particularly in those in which the extent of involvement cannot certainly be made out, general anesthesia should be used This applies particularly to the deep infections of the hand and other regions when the tendons are involved, and in infections of joints In extensive infections of the neck, as those along the carotid sheaths and in extensive infections of the cellular tissue, as in Ludwig's angina, general anesthesia is to be selected If nitrous oxide is available this furnishes the best means If this is not at hand ether should be used

Not only are there great technical difficulties to be overcome in treating suppurative processes under local anesthesia, but the problem is complicated by the disposition of the patient Patients with chronic pus infections are peevish and bear pain poorly Such difficulties may render a general anesthetic greatly to be desired even in relatively minor lesions In the hands of operators who are experienced in the use of local anesthesia the grosser lesions may be satisfactorily operated on

The Removal of Tumors

Superficial benign tumors furnish a broad field for the use of local anesthesia The simplicity of the technic often lures to the attack of malignant lesions with results often disastrous The removal of benign tumors usually furnishes the first lesson for the student of local anesthesia The encapsulated tumor demands little more than a linear skin injection, perhaps with

infiltration about the base Adherent or diffuse malignant tumors are the final task for the master in the use of local anesthesia An operator's qualification for the surgery of such tumors under local anesthesia is an accurate estimate of his own skill Only when he is satisfied that his ability is equal to any demand, is he warranted in undertaking the operation of a malignant tumor under local anesthesia Yet, when this condition is fulfilled, the surgeon may undertake, under local anesthesia by election, many major operations for the removal of tumors and almost any tumor operation may be performed, in the face of grave contraindications to ether, by this method The general problems involved can be presented best in the discussion of specific tumors

Circumscribed Benign Tumors

Small subcutaneous lipomas, wens and similar tumors may be removed after infiltrating a line over the summit (Fig 6), with additional infiltration beneath the base (Fig 7) In large tumors it is well to circumscribe an ellipse about the base or over the summit so as to remove any redundant skin (Fig 8) and also to inject solution beneath them (Fig 7) They can then be readily shelled out and the redundant skin can be used to cover the defect In these cases it is well to infiltrate extensively the tissues below the tumor, for it is here that the nutrient artery, with the accompanying nerve, lies, and unless it is well anesthetized the ligation of it will cause pain

Infiltrating Localized Tumors

In some varieties of tumors the skin may be involved, but the process is yet localized and requires local excision only Among these may be mentioned papillomas, nevi, endotheliomas and some slowly growing sarcomas To remove these the skin surrounding the tumor and the deeper tissues is infiltrated (Fig 8) and the entire growth, together with the capsule if there be one, excised The elliptical defect in the skin can be closed by sutures or by skin grafting

In such operations quinine or novocaine epinephrine may be used with equal satisfaction

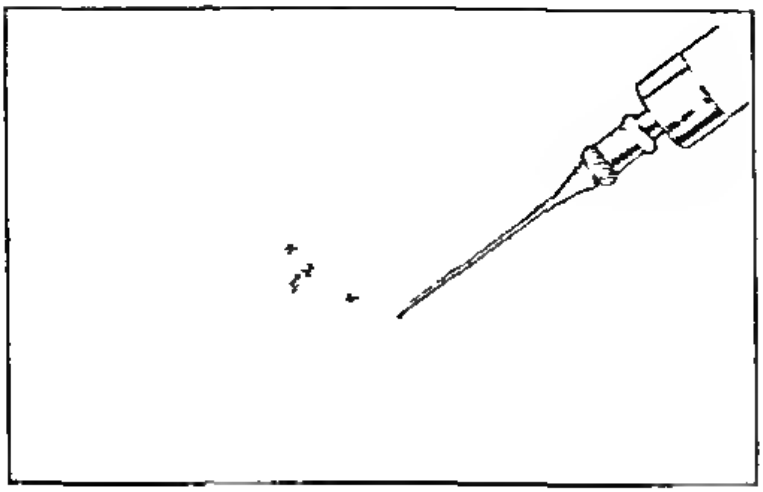

Fig 6—Showing the line of infiltration over the summit of a wen

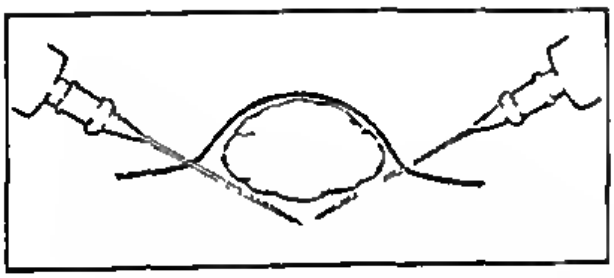

Fig 7—Showing method of edematization of the base of a tumor

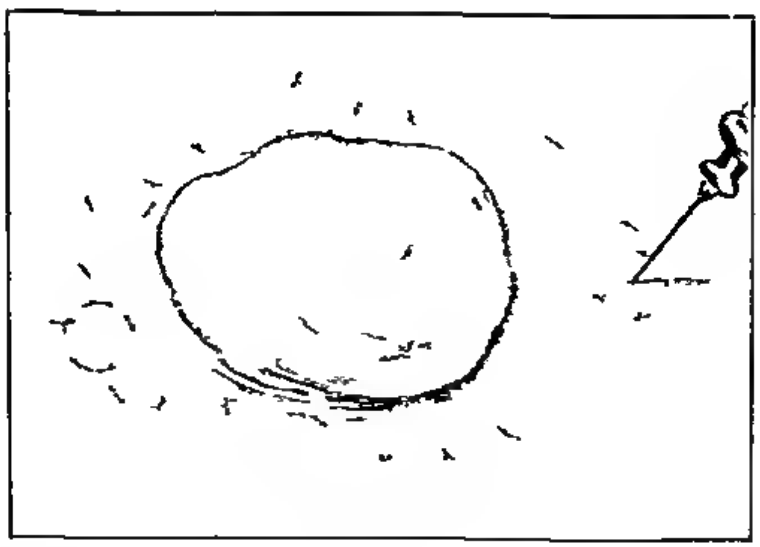

Fig 8—Method of injecting the skin about the base of a benign tumor

Malignant Tumors

Malignant tumors, predisposed to regional metastasis, force additional obligations upon the operator The removal of the tumor itself is the minor part of the operation The chief problem is the removal of the regional lymph glands Unfortunately many operators practice local removal of known malignant growths without this precaution and thus invite recurrence in the adjacent lymph glands This is done often in case of carcinoma of the lip Any tyro can remove the local lesion, but block dissection of the neck is a major operation

In all operations for malignant growths the technic when operating under local anesthesia should be identical with that employed when operating under general anesthesia If the operator does not feel that his technic is equal to the requirements, a general anesthetic should be resorted to at the outset Sometimes a two stage operation can be done to advantage The lymphatics should be removed first and the primary growth at a second operation This is a desirable procedure, particularly in tumors involving the mouth or tongue In this way the lymphatics are disposed of and the wound is allowed to heal before the mouth is opened into Infection of the extensive neck wound is thus avoided Besides if the local growth is removed first and the operator finds himself unable to complete the operation, the patient being relieved of the primary growth almost always fails to return for the removal of the neighboring lymph nodes

Operations for malignant tumors resolve themselves, therefore, into the technic of lymph gland dissection, and if the surgeon is not equal to this difficult procedure he should not attempt to operate metastasizing tumors

Generally speaking, malignant tumors are best operated upon under general anesthesia because the operation under local is tedious and time-consuming, and even in the hands of the most expert, some stage of the operation is liable to be abbreviated when unforeseen extensions are encountered The build of the patient affects the problem materially In the thin patient, any operation can be done with a great degree of satisfaction, but

in the corpulent the task may be stupendous In a large, obese woman a breast amputation under local anesthesia is a task that may well cause any surgeon to pause

Block dissection of the neck can well be done best under local anesthesia The presence of the anesthetist is avoided and the technic is rendered easier by virtue of the vessel constricting effect of the epinephrine The inguinal region likewise can be conveniently attacked

On the other hand, malignancies attended by infiltration of the skin from secondary infection are almost inoperable under local anesthesia

Recurrences, as in the skin after breast operations, are difficult to operate upon under local anesthesia because the extensive scar formation which followed the primary operation prevents the diffusion of the local anesthetic

The Search for Foreign Bodies

The removal of small foreign bodies usually falls to the lot of the beginner The problem is not a simple one, however, and the field should be sufficiently anesthetized to admit of wide dissection The size and probable depth of the object should be determined from the history Such information often prevents the misinterpretation of the x ray plates The tissues well about the foreign body must be infiltrated Often one may save the pain from the initial prick of the needle by inserting the needle in the hole made by the foreign body This is particularly true in the palm of the hand or sole of the foot If this is not done the infiltration should be begun in the thin skin of the dorsum, and the palmar or plantar skin anesthetized from above To begin the anesthetic in the thick skin of the palm or sole is exceedingly painful In a foreign body in the tip of the finger the infiltration should begin half an inch or more proximal to the nail and the field should be anesthetized from this point Sometimes after the parts have been anesthetized, the wire mandrin which accompanies some of the larger hypodermic needles may be made to follow the channel traversed by the foreign body Sometimes, too, in making the injection the needle comes in contact with the foreign body and thus aids in finding

it after the incision is made In any case, the infiltration must be made wide enough to be well beyond the foreign body The incision should be made at right angles to the long axis of the foreign body and not into the opening made by the entrance of the foreign body If this fails to reach it the wound should be palpated by the finger

Skin Grafting

Local anesthesia can be used effectively in the preparation of the bed as well as in anesthetizing the part from which the graft is to be taken Grafts may, of course, be placed upon fresh surfaces without previous preparation If the wound is covered by recent granulations, the surface may be curetted or better still cut off on the flat with a knife after anesthetizing the surface by compresses soaked in quinine or cocaine If granulations are not over four weeks old and are free from incrustations, exudates and notable infections, grafts may be placed upon them without previous preparation In old cicatrized ulcers, as varicose ulcers of the leg, the entire ulcer base must be excised Much care is required in anesthetizing such areas because of the extensive cicatrization which has taken place

The region from which the skin is to be removed is best anesthetized by infiltrating a horseshoe line with the open end of the shoe pointing toward the distal end of the extremity The infiltration should be made not only endermically but also subcutaneously, in order to block off the nerves Sometimes I have failed to secure anesthesia promptly in this way I have then resorted to subdermic infiltration of the entire region from which the graft is to be taken It should be emphasized that the injection should be made into the subdermic tissue and not into the skin itself If the latter is done, the healing of the graft will be interfered with materially After anesthesia is secured, the operation proceeds in the usual manner In this way grafting can be done with the least inconvenience, and the operator is often encouraged to graft small areas not large enough to justify the use of a general anesthetic It is easily carried out without any assistance, and should, therefore, commend itself to the general practitioner

The Suturing of Wounds

Usually in emergency work a linear injury to the soft parts is sutured without formality The sensibilities of the patient, however, can be spared by infiltrating endermically an elliptical line about the wound with novocaine The operator is then at liberty to trim the wound and cleanse it without annoyance to the patient A better suture line will be obtained if the repair can be done leisurely In large complicated wounds anesthesia is imperative In wounds attended by shock, nerve blocking tends greatly to overcome the general depression In extensive wounds of the extremities this can be particularly well carried out; brachial blocking in case of the arm, and spinal anesthesia in injuries of the lower extremity

CHAPTER IV

OPERATIONS ON THE SCALP, THE CRANIUM AND ITS CONTENTS

The cranial region offers a particularly favorable field for operations under local anesthesia because of the constant location and accessibility of the nerves supplying the scalp and the slight sensibility of the skull, meninges and brain This method is practicable for all operations in this region and for certain conditions it is mandatory It is especially satisfactory for the excision of the numerous tumors which involve the soft parts and for the treatment of injuries of the soft parts which require trimming and disinfection In injuries of the skull and brain and its membranes, whether they require the elevator or the trephine or not, local anaesthesia is by all odds the anesthetic of choice By its use the hemorrhage is lessened, the presence of the anesthetist and his apparatus is avoided and above all, postoperative vomiting is all but eliminated In severe accidents in which the cranium is injured, together with the mouth, pharynx, throat, or diaphragm, the use of local anesthesia for the management of the cranial injury is important because of the great danger from pneumonia after any form of inhalation anesthesia The method is particularly desirable if the head injury is accompanied by shock due to injury of other parts such as crushing of the extremities Vigorous use of the chisel and mallet is not well borne because of the unpleasant jarring, particularly if the patient is suffering or has previously suffered from headache It is well, therefore, in all cases in which the bone must be attacked, to give a preliminary hypnotic This is desirable even if the patient appears unconscious or stuporous Such patients, previously quiet, may be aroused to perform movements which annoy the operator once the use of bone cutting instruments is begun

For deliberate operations for cranial and intracranial disease, local anesthesia is an optional method, but it is not to be advised if the mentality of the patient has suffered because of the disease, as in post traumatic epilepsy with associated mental weakness, or if the patient has been a sufferer from severe headaches

due to increased tension from tumors If such patients are to be operated under local anesthesia they should be prepared by the administration of luminal a few days before the date of the operation followed by morphine atropine the usual time before the operation is begun

Local anesthesia is particularly desirable in exploratory operations for tumors where local motor symptoms are the chief guiding sign or where decompression is demanded because of developing choked disc Operations involving separation of the

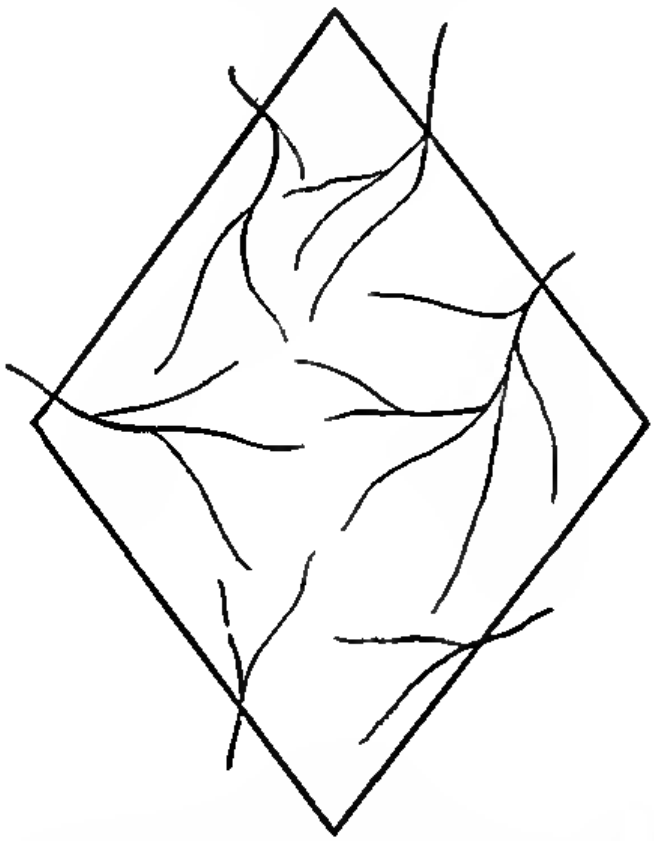

Fig 9—Schematic presentation of the method of nerve blocking where a number of nerves enter the field of operation

dura from the base of the skull, as in the trigeminal nerve roots and pituitary tumors, cannot be satisfactorily done under local anesthesia because of the source of the nerve supply to these structures

The technic of all operations involving the head is relatively simple The anesthetization as practiced for operations on the scalp is applicable as the preliminary step in operations on the skull or brain The various types of operations may, therefore, be well considered in sequence

Operations Upon the Cranial Soft Parts

When extensive operations are to be done upon the cranial soft parts, it is convenient to block the nerves at their entrance into the cranial field Because of their free interanastomosis with each other, it is necessary to block all those entering a given segment of the scalp The most important of these are the supraorbital, auricular and the occipital nerves The operator must, therefore, keep in mind the exact location of the nerves in question The anatomy of the more important areas may be reviewed here Because of the great number of different branches concerned in the innervation of many fields, it is best in addition to circumscribe the field of operation by an endermic infiltration (Fig 9)

The Great Occipital Nerve (Fig 10)

The great occipital nerve is the internal branch of the dorsal division of the second cervical nerve It passes through the triangular space bounded by the superior oblique, the inferior oblique and the rectus capitus major muscles and beneath the complexus muscle which it pierces and passes upward beneath the trapezium midway between the external occipital protuberance and the mastoid process Near the superior curved line it pierces the trapezius and divides into numerous branches which ramify in the scalp This nerve supplies the scalp in the occipital region but is reinforced by twigs from the small occipital nerve and a few twigs from the first cervical nerve These branches are of importance since blocking of the chief nerve in question may still leave sensation in the skin of the occiput below the superior curved line It is best blocked by passing the needle point beneath the trapezius muscle midway between the external occipital protuberance and the tip of the mastoid process The needle should be passed parallel with the lower surface of the occipital bone

The Small Occipital Nerve

The small occipital nerve is a branch of the second cervical It passes upward under cover of the posterior border of the sternomastoid muscle, reaches the scalp of the posterior border

of the mastoid process and anastomoses in the integument of the great occipital and the great auricular nerves. It is best reached for blocking immediately behind the posterior border of the mastoid process.

The Auriculotemporal Nerve

The auriculotemporal nerve is a branch of the third division of the fifth nerve It passes backward and outward between the

Fig 10.—Distribution of the nerves supplying the scalp

internal ligament of the temporomandibular articulation and the condyle of the jaw, traverses the under surface of the parotid gland, and crosses the root of the zygoma where it divides into the auricular and temporal branches which supply the lateral surface of the scalp. It is most easily blocked just above the upper surface of the zygoma just posterior to the temporal artery.

The Frontal Nerves

The frontal nerves represent the first branch of the fifth nerve The larger of its branches passes through the supra orbital foramen (or notch) and extends upward to supply the skin of the forehead and anterior cranial region A smaller branch reaches the forehead medial to this The foramen is a finger breadth lateral to the lateral border of the nose, and the nerve can best be blocked here If a notch exists it can be pal pated in many instances and the injection made at the exact spot desired A foramen may generally be located by feeling for it with the point of the needle If neither succeeds, the deposition of an excess of the anesthetic solution may make up for the lack of exactness in technic The medial branch may be reached by infiltrating the subdermic area just lateral to the lateral border of the nose

Though the technic of anesthetization is similar in all opera tions of the scalp in principle each procedure presents slight variations worthy of note The commoner lesions may be de tailed

Wounds of the Scalp

In large wounds of the scalp, in which extensive cleansing, trimming and shaving of the soft parts are required, nerve blocking finds perhaps its most frequent use Under such con ditions to have a broad field anesthetized unhampered by the apparatus incident to general anesthesia, and especially to know that no haste is required, is an efficient stimulus to do thorough work When the injury extends to the borders of the cranium, the main nerves supplying that region should be blocked at their source Twigs from other than the main nerve may necessitate endermic infiltration The operator should distinguish between the sensation caused by these twigs and pain from inadequate blocking of the principal nerve When an injury extends across the field of several nerves, this endermic infiltration about the entire injured area may save time For instance an injury across the temporofrontal region may invade the field of several trunks Infiltration in such instances may be simpler than the blocking of several nerve trunks

In small wounds of the scalp, it is often more convenient to pass the needle from the cut edges of the scalp rather than through the surface of the intact skin This maneuver causes less pain when making the infiltration The danger of carrying infection into the deeper parts by so doing is theoretical specu lation In a neglected wound less pain will be caused by infil trating an ellipse about it well free from the inflamed area than by entering the skin from the injured edges as recommended for fresh wounds

Obviously, of course, the head is to be shaved and the skin disinfected before the anesthetic is injected However, in wounds which have already begun a reactive inflammation the *cleansing itself may cause great pain* In such cases it is well to saturate skin and hair near the chief nerve trunk with iodine and block it with 5 c c of the anesthetic solution A needle may then be passed between the skull and overlying soft parts and a quantity of the anesthetic solution deposited The disin fection of the wound may then be proceeded with without dis comfort to the patient

When the wound lies near an important arterial trunk the vessel should be sought for and ligated Smaller bleeding points are readily controlled by the coaptation sutures, partien larly if figure of eight sutures are used The scalp is the only region in which coaptation sutures may properly be used as hemostatic sutures as well The skin of the scalp is the least sensitive region of the body and tight sutures cause relatively little pain

The Removal of Tumors

The removal of small benign tumors of the scalp presents per haps the most simple exercise in the use of local anesthetic Though rare, complications sometimes set in and care must al ways be exercised In papillomas and other tumors involving the skin, an elliptical line is infiltrated about the base of the tumor and a few cubic centimeters are injected beneath the tumor In encapsulated tumors, such as dermoids and wens, the space between the tumor and the skin may be edematized This additional infiltration facilitates removal

Operations on the Skull

The skull bones seem to be less sensitive than other bones The simple infiltration of the scalp gives complete anesthesia It must be that the skull has no sensitive nerves It is not likely that diffusion from the scalp infiltrations could cause anesthesia Immediately the scalp is infiltrated one may cut down to the bone and begin the skull operation without causing the patient any pain The subcutaneous surface of the tibia, on the contrary, is exquisitely sensitive after the overlying skin has been anesthetized and it requires time and care to secure anesthesia It seems fair to assume, therefore, that the skull has no sensory nerves

Injuries

Local anesthesia can be employed in all injuries of the cranial bones with the advantage already noted The precautions mentioned in injuries of the soft parts must be observed here

The scalp in the region of a fracture of the skull is circumscribed by a line of infiltration Usually a circle at least three inches in diameter should be circumscribed by a line of endermic infiltration From this line the subcutaneous tissue is infiltrated in the direction of the chief nerves supplying the region It is desirable to have a large area anesthetized for in a fracture one never can be sure of the area over which the operation must extend In order to elevate depressed bone, if an opening large enough is already present, the loose pieces can be pried up by an elevator without further preliminary manipulations If there is no such opening a trephine opening is made through uninjured bone as close as possible to the line of fracture From this opening the bone is snipped with a Dahlgren forceps until the dislocated fragments can be elevated This part of the procedure is entirely painless but care must be exercised lest the movements imparted to the head annoy the patient Before the bone is elevated it is worth while to tell the patient that it is going to "pop", this prepares him for the sensation of lifting experienced in the brain when the fragment is raised The subsequent treatment follows accepted principles

Exploratory Operations

Local anesthesia is of great advantage in these operations because the hemorrhage is vastly less annoying One can convince himself of this by giving ether after the brain is explored The previously dry wound will begin to bleed at a thousand points as the venous pressure rises with the inhalation of the anesthetic

In the desired region, usually over the motor area, a horseshoe shaped figure is infiltrated more than 1 cm beyond the line

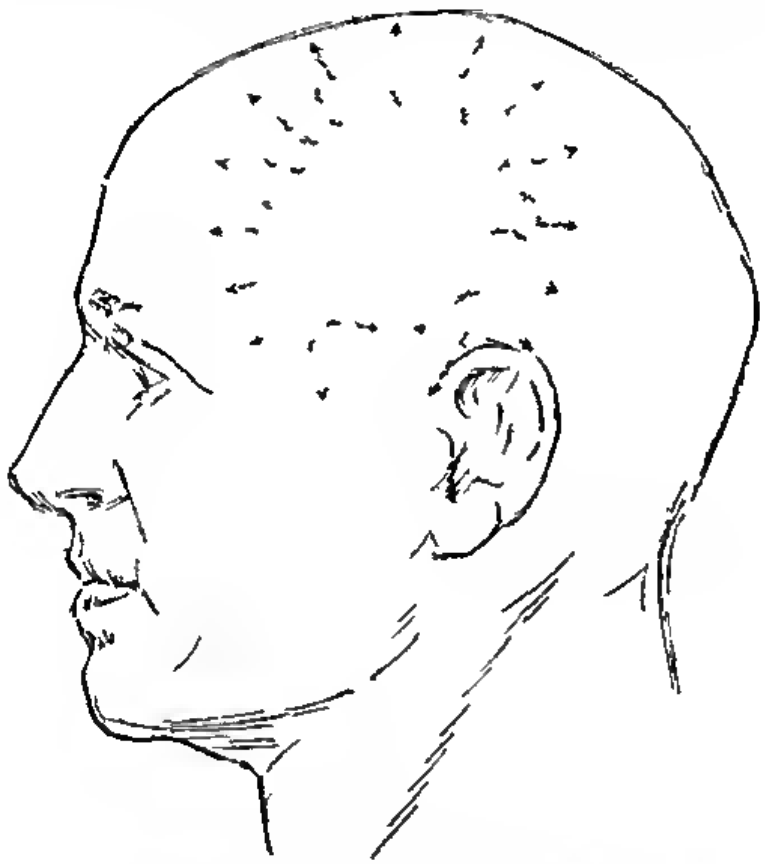

Fig 11—Primary infiltration line with secondary subdermal lines for the typical cranial flap operation

in which it is proposed to sever the bone It is well to infiltrate the skin directly and likewise to edematize the tissue between the bone and the scalp From this line injections are made beyond the line of infiltration, beneath the flap and beyond its base (Fig 11) An incision is now made down to the skull in the line infiltrated The scalp is elevated toward the center of the flap and slightly beyond the outer border of the infiltration line Trephine openings are made at two points at the upper

margin of the flap in the classical way Before the buttons loosened by the trephine are elevated the patient should be told that he will hear a popping noise An intelligent automobile engineer upon whom I operated compared this noise with the back firing of an engine, but did not complain of any pain The two trephine openings are united with a Gigli saw in the usual manner The passage of the protecting director is painless and requires no anesthesia after the skull is opened The patient before mentioned felt no pain from the use of the saw, but felt the sensation of heat when the saw began to warm from friction and was able to tell me when it was time to cool the saw He was able, therefore, to differentiate between the heat and pain sense The lateral limbs of the flap are made in the usual way with Dahlgren forceps A large and powerful instrument should be used in order that the bone may be cut without imparting movements to the patient's head The base of the bone is broken in the usual manner, the patient being warned that there will be a loud popping noise when the flap is raised The patient above quoted compared the noise to the bursting of an automobile tire The flap being raised, the operation may proceed in the usual manner The meninges and brain are quite insensitive This is equally true if quinine or novocaine has been used as the anesthetic for the soft parts My experience with quinine makes me feel certain that the meninges and the brain are insensitive because when the skull is opened by endermic and subdermic infiltration there is no sensation of pain The argument that these structures are made painless by the diffusion of the anesthetic is untenable when quinine is used

In doing exploratory operations in epileptics it is exceedingly embarrassing to have a fit come on during the operation In such an occurrence during one of my operations the brain bulged enormously during the convulsions and it required firm pressure with gauze pads to prevent lacerations of the brain

Decompression Operations

The general procedure for both occipital and temporal decompression operations is the same as the preceding I have always done occipital decompression under local anesthesia

with a good deal of trepidation I have feared diffusion of the anesthetic through the dura into the medulla This accident has never happened to me or any one else so far as my knowledge goes Nevertheless, I fear its use It is necessary in addition to the skin infiltration to make quite extensive infiltration into and below the muscles surrounding the foramen magnum in order to secure anesthesia

The small bite from a powerful Dahlgren imparts less unpleasant movements to the head than the usual rongeur forceps and for that reason the former is preferable Patients who require decompression because of headaches do not bear local anesthesia well Even if not suffering from headache at the time of operation they complain that the sawing of the trephine causes a pain distributed over the entire head Unless the indication is urgent these operations had best be done under general anesthesia

Operations Upon the Cranial Contents

As before stated, the brain and the meninges are insensitive and one may manipulate them at will When lesions within the brain are to be dealt with it is probably prudent to do a two stage operation because of the changes in intracranial pressure likely to be produced Dural cysts and blood clots can be removed and even ventricular puncture can be made without ill effect at the time of the primary operation, but so far as I know no one has attempted the removal of a tumor at the primary operation when working under local anesthesia Cushing has shown that this can be done painlessly at a second sitting

Operations on the Base of the Skull

The dura over the vault of the skull can be separated without causing pain At the base of the brain the problem is different Here the separation of the dura causes intense pain and attempts at anesthetization by subdural injection in my hands have met with failure The reason for this is simple enough, the dura at the base of the brain is supplied by nerves coming from branches of trifacial, either before or after they leave the skull and by recurrent branches from the vagus and hypoglossal nerves Operations in this region, therefore, should be done

under general anesthesia or the first part of the operation may be done under local to be followed by a general anesthetic when the dura is reached Section of the sensory root may be satisfactorily performed under local anesthesia, as shown by Coughlin After the base of the skull is approached he uses pledgets of cotton saturated with anesthetic solution This, together with the utmost gentleness in technic, is the basis of his success

CHAPTER V

OPERATIONS ON FACE, JAW AND TONGUE

Operations about the face and jaws involve chiefly the field supplied by the trifacial nerve, and the technic, therefore, has to do chiefly with the blocking of the various branches of this nerve.

In general, three principal indications bring the surgeon to attack this region neuralgias which demand the blocking of one or more branches merely for the relief of pain, major operations which require the removal of a considerable portion of the bony framework, and finally the lesser affections of local nature The first two demand nerve trunk blocking while the latter can usually be easily managed by local infiltrations

In most areas in which nerve blocking is required, the surgeon has to deal only with technical difficulties In and about the base of the skull there are in addition certain dangers that must be taken into account The size and number of the sinuses and the motor nerve and those of special sense must be regarded Injections about the orbit are particularly liable to bring embarrassment If the optic nerve is temporarily anesthetized it so fixes the patient's attention that he is liable to hold the surgeon responsible for all future conditions not to his liking even to such obvious dissociated conditions as presbyopia and cataract.

The most frequent operations about the face and jaws are those required for malignant disease Local anesthesia is particularly desirable in these conditions because it allows freedom of action unhindered by the anesthetist and his paraphernalia Even more important is the fact that one can better protect the patient against the aspiration of blood and infectious material, in a great measure insuring him against postoperative pneumonia.

Besides, local anesthesia has the advantage of enabling one to secure consent for earlier operation, permits more readily

two stage operations, makes dissection less bloody That the advantages are real is attested to by the fact that operators who have once familiarized themselves with the technic do not abandon the method for general anesthesia

We have recently used intravenous sodium amytal for large malignancies of the jaws requiring extensive cauterization It is less time consuming for the operator than local anesthesia

It is conducive to simplicity to discuss in turn the areas supplied by the various branches of the trigeminus, taking up in turn the orbit, the upper jaw and the lower jaw and tongue

Neural Anatomy of the Face, Jaws, and Neck

The neural anatomy of the face and jaws is coextensive with the distribution of the three branches of the fifth cranial nerve Each branch of this nerve after it emerges from the gasserian ganglion takes its separate way to reach a foramen through which it emerges from the skull to reach its ultimate destination

When the nerve is injected before it makes its exit from the skull it is called intracranial, or if the ganglion itself is injected, intraganglionic If the nerves are injected at the point of emergence from the skull it is basal, and if in the course of distribution, the injection is peripheral These various relations must, therefore, be noted The intracranial injections are considered in a separate chapter

First Branch—The first branch, the ophthalmic nerve, emerges from the gasserian ganglion and transverses the lateral wall of the cavernous sinus Just before its exit from the skull it divides into the nasociliary, frontal and lacrimal

The Nasociliary—This nerve passes along the medial border of the orbit and supplies the skin of the forehead above the root of the nose, the upper and lower eyelids and the side of the nose

The Frontal—The frontal nerve follows the roof of the orbit and reaches the forehead through a foramen or a notch a little medial to the midpoint of the supraorbital crest It supplies the skin of the forehead

The Lacrimal—The lacrimal nerve follows the lateral border of the orbit and reaches the skin at the outer canthus It supplies the skin of the lateral part of the forehead and the temple

The Second Branch—The maxillary nerve, after its escape from the gasserian ganglion, passes through the foramen rotundum to reach the pterygopalatine fascia Here it gives off branches which supply the mucosa of the posterior nasal fossae, the pharynx, and the palate and upper teeth Proceeding, it

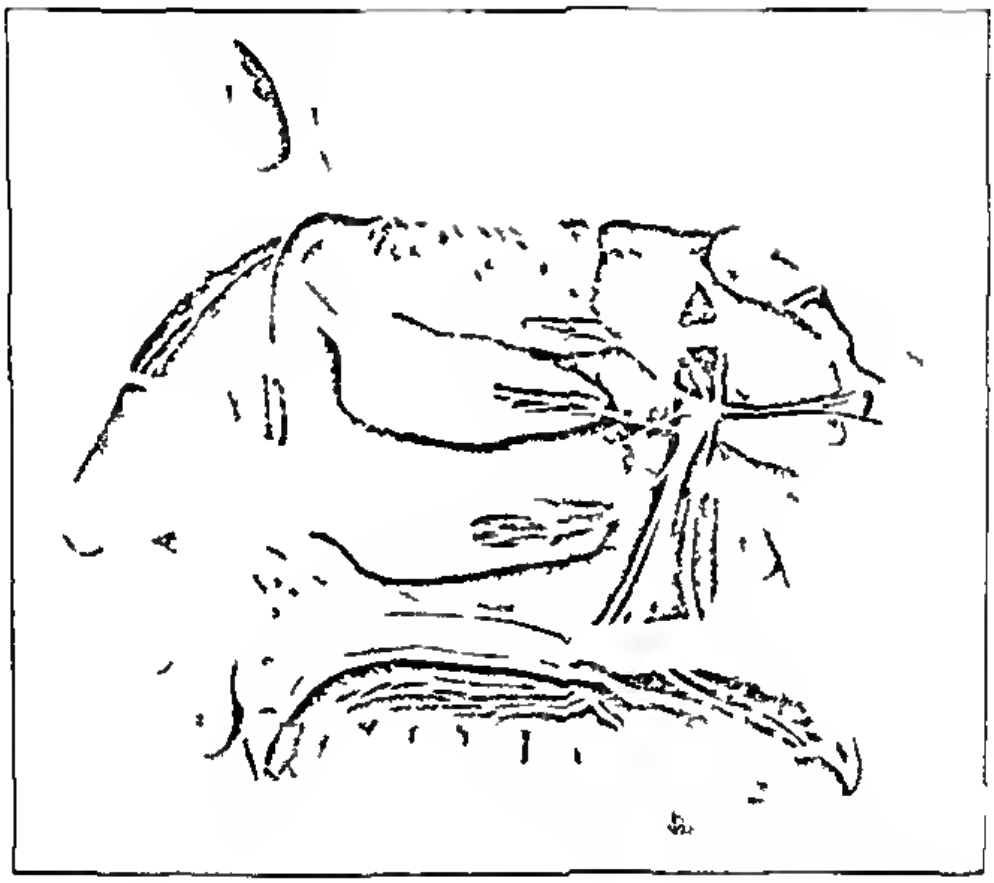

Fig 1°—Sphenopalatine nerve supplying the turbinate and palatal regions

enters the infraorbital canal, escaping from the infraorbital foramen, it supplies the lips and cheek Before it enters the infraorbital canal, it gives off the following two branches

The Sphenopalatine—This branch traverses the palatine canal One portion escapes to supply the mucous membrane of the palate (Fig 12) Another portion, continuing along the floor, passes through the foramen incisivum to supply the mucous membrane of the anterior portion of the hard palate and gums

The Superior Alveolar.—The superior alveolar branches are given off from the infraorbital nerve posterior to and within the canal. They traverse the superior maxilla and supply the teeth of the upper jaw after freely anastomosing with one another (Fig. 13).

The Infraorbital.—The infraorbital divides into branches which supply the skin of the face, the buccal mucous membrane, the floor of the nose, and the incisor and canine teeth. (Fig. 13.)

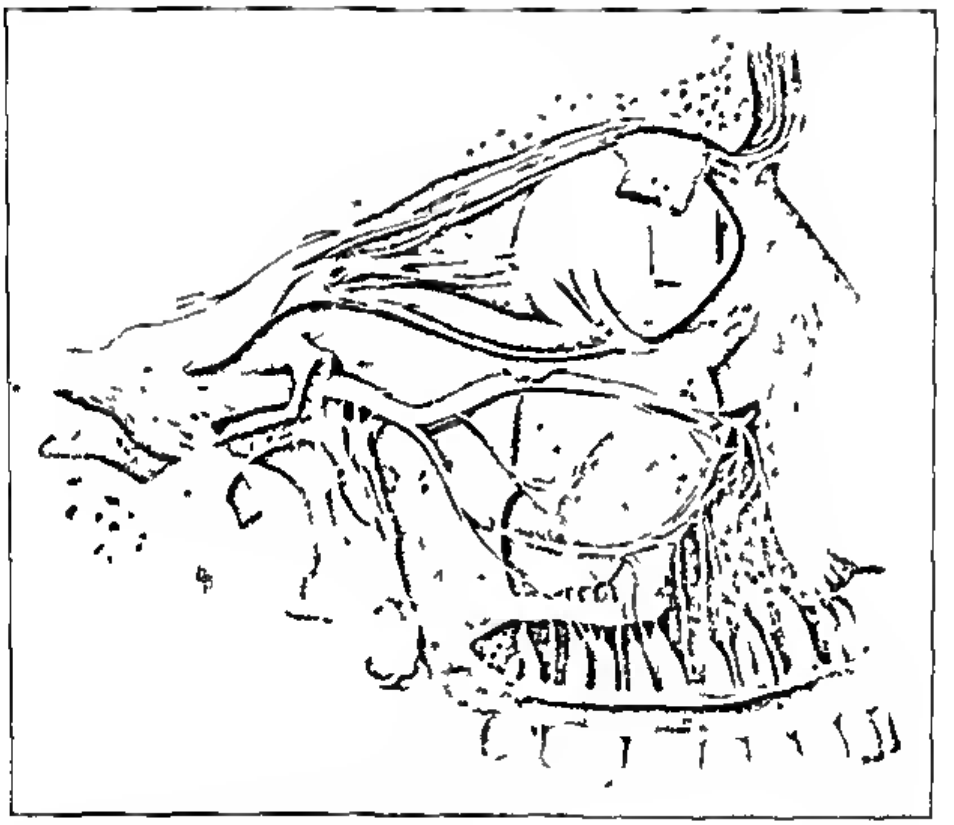

Fig. 13.—First and second branches of the trifacial nerve. Note the superior alveolar branch of the second division supplying the teeth.

The Third Branch.—The third branch originates in the gasserian ganglion. It escapes from the cranial cavity through the foramen ovale and divides into a motor portion, which is of interest in this connection, divides into the auriculotemporal, the buccinator, the lingual and the inferior alveolar branches.

Auriculotemporal.—The auriculotemporal nerve arises near the middle meningeal artery, passes upward and outward behind the articular process of the lower jaw and ascends upward

between the meatus and the posterior root of the zygomatic arch and continues upward along with the temporal artery. It supplies (a) branches to the parotid gland; (b) to the external meatus; (c) to the external ear; and (d) the skin of the temple region. (Fig. 14.)

Buccinator.—The buccinator nerve is derived from the anterior division of the mandibular nerve. It passes between the heads of the external pterygoid muscle and reaches the cheek

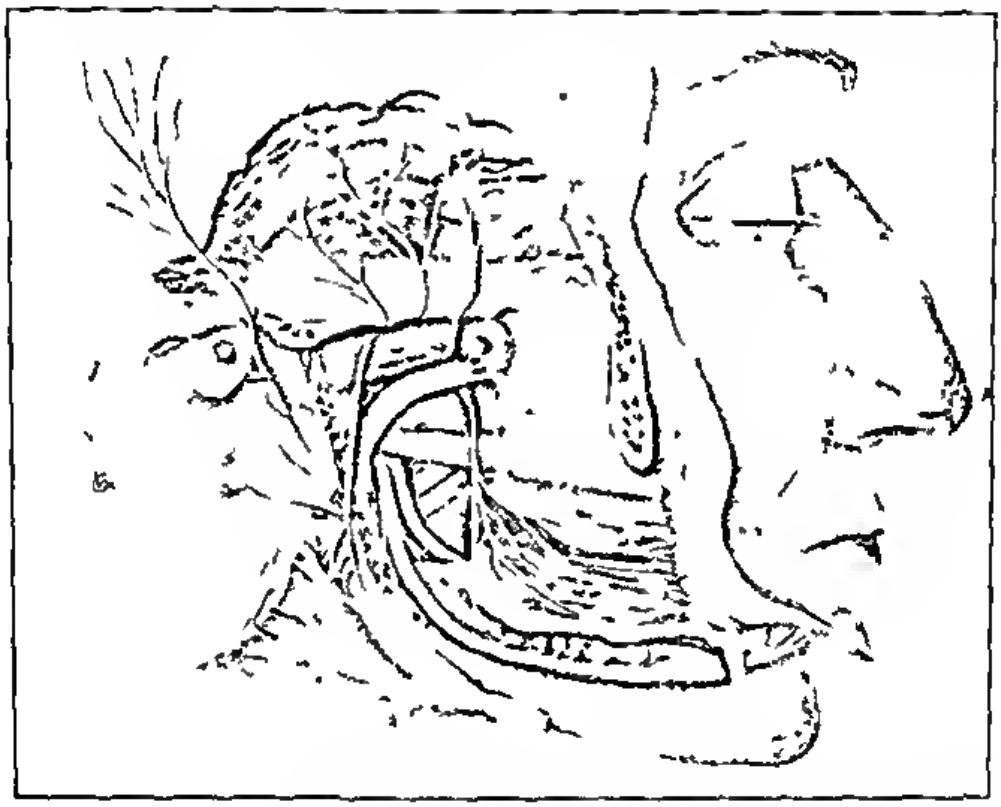

Fig. 14.—Third branch of the trifacial. Note the auriculotemporal, the buccinator, and the alveolar and lingual branches.

between the buccinator and the masseter muscles. It supplies the skin of the cheek and the mucous membrane of the mouth, extending to the mucous membrane of the gums.

Inferior Alveolar.—At the exit from the space between the external and internal pterygoid this separates from the lingual nerve and is directed toward the inferior dental canal. It follows the canal, giving off branches to the teeth and escapes again at the mental foramen and supplies the skin of the chin and lower lip.

The Lingual—The lingual nerve derived from the third branch at the level of the internal pterygoid muscle passes downward and medially to the side of the genioglossal muscle where it divides into its branches, the sublingual supplies the mucosa of the floor of the month and the medial surface of the jaws The terminal branches supply the mucosa of the tongue from the circumvellate papillae to the tip

Operations Upon the Orbit

Operations upon the orbital soft parts can be done under regional infiltration Novocaine should always be used If the operation is to be extensive, the respective nerves may, as a preliminary, be blocked within the orbit, according to the methods to be described A word of caution is required here Before injections are made within the orbit for any purpose except enucleation, the eye should be examined by a competent oculist If this is not done, any defect of the eye already present or that may develop in the future is liable to be ascribed to the injection This is particularly true in cases in which the optic nerve is temporarily anesthetized Even with these precautions such eyes should be bandaged until full vision has been restored All tumors, including those of the bones, can be satisfactorily removed in this way The operation of enucleation requires an additional injection into the muscle sheaths

Operations on the Frontal Sinus

For operations upon the frontal sinus the skin and periosteum must be infiltrated at the site of the proposed incision, which depends upon the precise operation intended If Killian's operation is to be done, the infiltration can be made along the lower border of the ciliary ridge and down the lateral border of the nose This, together with the blocking of the ciliary and supraorbital nerves and the use of cocaine or quinine tampons within the nose, enables the operation to proceed painlessly On the whole, however, because of the many sources of the nerve supply and the difficulty of blocking them with certainty, local anesthesia is selected only when there are contraindications for general anesthesia

Operations on the Soft Parts of the Face

Because of the multiplicity of origin of the nerve supply to this region infiltration of the soft parts about the lesion is the method of election This may be supplemented by blocking the infraorbital nerve at the foramen if the operation is extensive This answers very well for the excision of tumors and the ordinary plastic operations In plastic operations involving the nose this method is not satisfactory unless only the skin is to be attacked If the interior of the nose is to be entered, the nerves supplying this region must be blocked The local use of anesthetics within the nose does not give good results In general, inhalation anesthesia should be selected for these extensive operations unless there is a distinct contraindication

Operations Upon the Upper Jaw

Local anesthesia can be satisfactorily used for all operations involving the alveolar border including the extraction of teeth The removal of the entire jaw may be done, but the blocking off required is extensive, the lack of bleeding and the allowing of the use of the cautery make it the anesthesia of choice

Extraction of Upper Teeth

In the extraction of teeth pain is caused when the tooth is torn from the gum, when the root is separated from the periosteum, and when the root nerve is ruptured Pain from the gums is readily controlled by submucous injection with either quinine or novocaine epinephrine Pain from the initial prick of the needle may be prevented by the application of cocaine or of the carbol menthol cocaine mixture of Bovaın With or without one of these preliminary measures the needle is thrust obliquely into the gums, at a point over the alveolar border of the bone (Fig 15) and not at the free edge of the gum In this way one may anesthetize by diffusion the free edge of the gum which comes in contact with the instrument and may also reach more readily the periosteum about the roots of the teeth

A special syringe is advised for the purpose, since the pressure required is greater than can be secured with an ordinary instrument The needle is introduced just beneath the mucous membrane and a few drops of the fluid are injected The needle

should be passed so that the beveled edge of the point faces toward the bone (Fig 16) The needle is then made to penetrate the periosteum and the solution is deposited under pressure Some writers recommend that the fluid be deposited upon the periosteum and allowed to reach the nerve by diffusion There can be no question however but that subperitoneal infiltration

Fig 15—Direction of the needle in anesthetization of the upper teeth

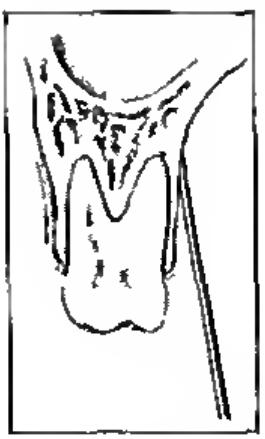

Fig 16—Showing the relation of the beveled edge of the needle to the bone surface

gives more prompt and certain results The needle should be introduced where the bone is smooth so that it may pass readily between the bone and the periosteum

The technic must vary somewhat with the region operated upon because of the differing thickness of the bone and the corresponding variation of time required for the fluid to reach the nerves For instance the thin plate of the upper jaw permits

diffusion through it, blocking the nerves where they enter the roots, while in the lower jaw the thickness of the bone is such that the nerve can be reached only before it reaches the lingula or at the roots of the teeth by diffusion of fluids injected about the necks of the teeth

In addition to local infiltration, nerve blocking may be resorted to, particularly when a number of teeth are to be operated on at one time The posterior superior alveolar and the infraorbital nerves are accessible for blocking These nerves enter the alveolar process and supply the three molars They are blocked by introducing the needle at the fold of the buccal and alveolar mucous membrane above the second molar and passing it along the bone for about an inch One or two cubic centimeters of fluid should be deposited here In addition to this, Fischer recommends a submucous injection in front of the first molar and likewise an injection over the posterior palatine foramen This should anesthetize all the upper molar teeth

The anterior superior alveolar nerves are given off from the infraorbital just before it escapes from the canal In order to block them, the fluid should be deposited at the foramen, which is usually ¼ inch from the orbital border over the first premolar The needle is entered at the point where the mucous membrane of the lip curves to the gingival surface By raising the lip the needle can be made to approach the foramen at an angle One cubic centimeter of fluid is deposited under as much pressure as possible The nerves at the incisive foramen must also be injected If the operation is to approach the median line, the nerves of the opposite side should be injected in a like manner Instead of injecting the infraorbital foramen from the buccal surface it may be reached more directly by penetrating the skin directly over the foramen and introducing the needle ¼ inch into the canal By this means the nerves are more certainly reached The injury to the skin made by the needle is negligible

Tumors of the Alveolar Process of Upper Jaw

For the removal of small tumors, such as granulomas or epulides, local infiltration as above described is sufficient If the tumors are large or within the alveolar process, blocking of the

second branch at the foramen rotundum, according to methods already described, is necessary In this case one must block the nerves in the pterygopalatine fossa and infiltrate beneath the mucosa along the anterior surface of the upper jaw Such submucous infiltration may be sufficient in itself if time enough be allowed, but in this case the mucous membrane of the antrum may remain sensitive One may then inject directly into the antrum through the inferior nasal fossa This will not be effec

Fig 17 —Line of skin infiltration in resection of the upper jaw

tive if the antrum is infected The usual instruments employed for such operations may be used A biting forceps is preferable to a chisel

Resection of the Upper Jaw

Resection of the upper jaw below the orbital plate is accomplished by infiltrating the tissues over the outer surface The solution deposited over the bone quickly reaches the superior alveolar nerves (Fig 13) By sliding the needle behind the bone the sphenopalatine nerve (Fig 12) can be surrounded with

a pool of the anesthetic fluid The mucosa of the hard and the soft palate is easily directly infiltrated, as well as the nasal septum and the tissues about the zygomatic arch

This done the soft tissues can be served with a cautery without any bleeding The bones are easily severed with a blow of the chisel A twist of the severed bone separates it from the pterygoid process

In women the operation may be done without making any incision in the cheek In males a straight incision from the angle of the mouth backward makes the operation simpler The regular Weber incision (Fig 17) gives a still easier access

Infections of the Antrum

The external surface may be anesthetized by infiltrating fully between mucosa and bone and in the nose by local application of cocaine The mucosa lining of the antrum still remains sensitive to a degree depending upon the nature of the pathologic process Usually the diffusion through the bone is sufficient to make this pain negligible Any of the standard operations may be carried out with satisfaction

Operations on the Lower Jaw

Major operations on the lower jaw are simpler than procedures of like magnitude on the upper jaw Any of the standard operations may be done With care and experience these operations become astonishingly simple Before attempting the excisions of the jaw, I hesitated lest the mental effect of the removal of the jaw would prove a source of shock This anticipation was not fulfilled Patients bear the saw without complaint and speak as calmly with the tongue rolling out of the wound as though they were not being subjected to any unusual experience

The lessened hemorrhage and the freedom from the interference of the anesthetist make local anesthesia less annoying to the operator than general anesthesia The effect on the patient is most gratifying. While they may flatten out somewhat during the course of operation, they are pretty sure to be sitting up before many hours The advantage of this in the prevention of postoperative pneumonia will be readily understood by those who have done much work of this character.

Extraction of Lower Teeth

The alveolar process of the lower jaw being thicker and more dense than the upper, it is less easily anesthetized by subperi toneal infiltration However, for simple tooth extraction a care ful subperiosteal infiltration (Fig 18) and infiltration about the

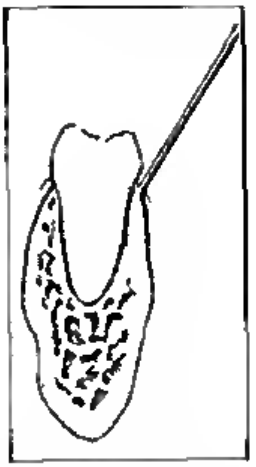

Fig 18—Method of anesthetization of the teeth of the lower jaw The anesthetic fluid is injected about the neck of the tooth so that the diffusion may take place throughout the socket

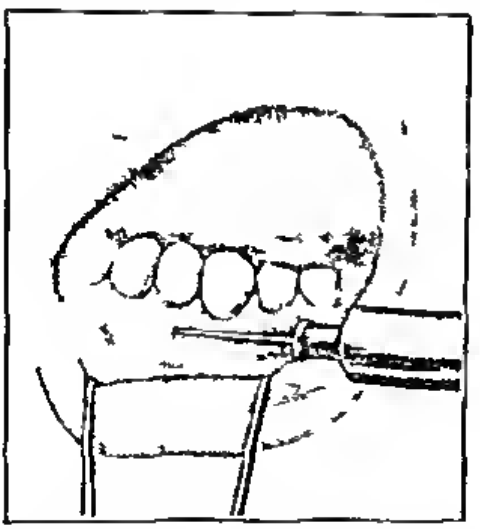

Fig 19—Point of injection for the premolar teeth

roots of the teeth (Fig 19) relieve all the pain except that produced by the rupture of the nerve and often, particularly if the fluid has been allowed to act for some minutes, this part of the operation also may be painless Where many teeth are to be extracted, the main nerve trunk should be blocked

The lower jaw is supplied by nerve trunks which maintain definite anatomic relations to fixed points, which are suitable regions for nerve blocking The inferior alveolar nerve offers the most simple task in major nerve blocking The lingula,

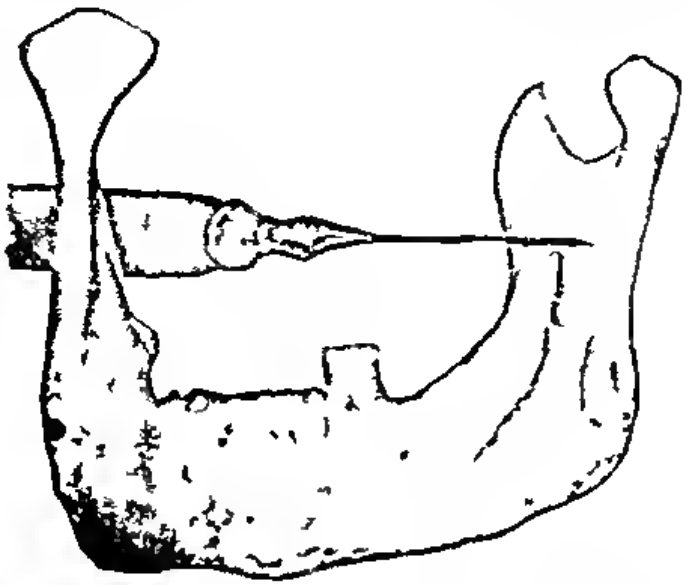

Fig 20—Relation of the tip of the needle to the lingula when the injection is made for blocking the inferior alveolar nerve

Fig 21—Showing the relation of the syringe and needle to the jaw in making the injection for blocking the nerves at the lingula.

which is usually palpable through the mouth, marks the entrance of the nerve into the bone and indicates its most accessible portion The injection is made at a point ½ inch above the surface of the molar teeth and the needle should penetrate

slightly more than ½ inch and less than ¾ inch beyond the anterior border of the ascending ramus (Fig 20) This point may be best located by placing the index finger of the left hand behind the last molar and by resting the tip on the internal oblique line By passing the needle through the mucous membrane, just above the finger, and penetrating ½ to ¾ inch in depth, the nerve will be reached Owing to the obliquity of the ascending ramus the needle must be passed not in the line of the teeth but from the canine tooth of the opposite side (Fig

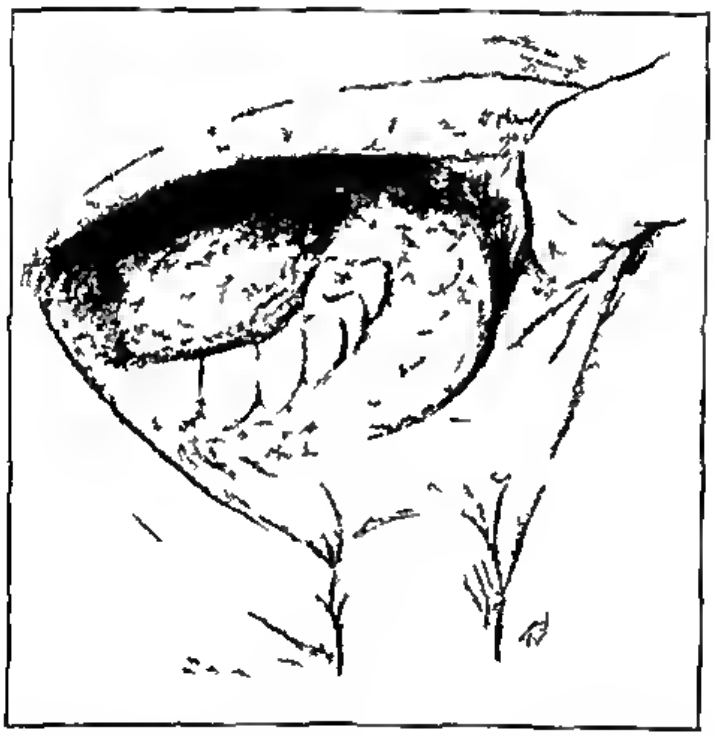

Fig 22—Submucous infiltration for operation upon a dentigerous cyst

21) Passed in this line the needle tip comes to lie in the vicinity of the nerve where an injection of 2 c c of the solution should be made By injecting a few minims as soon as the needle has penetrated the mucous membrane, and depositing a few drops from time to time the entrance of the needle can be made painless If this technic is properly carried out, anesthesia will be complete in about twenty minutes All the teeth, as far as and including the premolars, are anesthetized In order to reach the teeth beyond this point, toward the median line the nerve must be blocked at the opposite mental foramen which lies at

the base of the alveolar process beneath the first and second premolar teeth To reach the second premolar teeth, the injection should be made below it between the buccal and the gingival mucous membrane

Tumors of the Alveolar Process of Lower Jaw

Granulomas and small epulides can be removed by local infiltration Large tumors require the blocking of the nerves at the lingula and also local submucous infiltration The mucosa of the lateral border of the jaw opposite the molar teeth is supplied by the buccinator nerves and the medial border by branches from the lingual These areas, therefore, require submucous infiltration It is well in such cases to infiltrate the mucosa directly over the tumor or about its border (Fig 22) If the tumor is situated near the median line, the nerve of the opposite side must be blocked at the mental foramen The necessity for infiltrating the mucous membrane about the tumor if the tumor be situated opposite the canine teeth, comes from the fact that there is free anastomosis from other nerves the exact source of which may be difficult to understand This is no great disadvantage, for after infiltrating about the nerve trunks at the lingula, some time elapses before these nerves become anesthetized, and the operator may employ this time infiltrating the mucous membrane

CHAPTER VI

OPERATIONS ON THE EAR AND MASTOID

Operations on the external ear are easily accomplished by local infiltration. Anesthetization in operations involving the mastoid or middle ear is difficult particularly when it is inflamed because of the close adhesion of the covering soft parts to the bony structures beneath. Very sharp needles of small lumen and syringes of narrow caliber are desirable. The injections must proceed very slowly and accurately.

The external ear and auditory organs have such a complex nerve supply that local infiltration only can be employed. The external ear is supplied by the auricularis magnus and the auriculotemporal chiefly. The latter nerve also supplies the skin and mucous membrane of the external auditory canal. The organs of hearing are supplied by the auricular branch of the vagus. The middle ear and the eustachian tube are supplied by the tympanic branch of the glossopharyngeal. The mastoid cells are supplied by the mandibular nerves through the spinosus.

Furunculosis of the External Meatus

This exceedingly painful affection is difficult to anesthetize but the following methods employed for the tympanic membrane give at least partial results. Complete anesthesia may be secured by beginning the infiltration in the unaffected skin at the periphery of the affection and gradually circumscribing it. The greatest gentleness is necessary in order to avoid pressure pain from the fluid before anesthesia takes place. Cocaine is the most effective for this operation. Local anesthesia is best avoided if gas is available or a few whiffs of concentrated ether vapor (the so called ether rausch) should be used instead.

Paracentesis

Various means have been employed to lessen the pain of paracentesis on the drum membrane. Most of the solutions used for

this purpose contain carbolic acid and cocaine The one recommended by Hechinger is as follows

Acid Carbolic	9ss	gr vii
Cocaine		
Menthol	aa	gr xxx
Alcohol		dr iss

A bit of cotton is saturated with this solution and pressed against the tympanic membrane for a few minutes Bonain uses an even stronger solution of carbolic acid as follows

Phenol Crystals		
Menthol		
Cocaine	aa	1 gram

To this may be added several drops of epinephrine

Usually no attempt at injection is worth while since the operation of incising the membrane is no more painful than are the injections used to produce anesthesia

The Mastoid Operations

As the method of choice, operations on the mastoid are done under general anesthesia, but emergency operations are not infrequently required in the course of general diseases, notably scarlet fever, typhoid fever and respiratory diseases My own experience in this operation has been limited to those cases in which a general anesthetic was contraindicated or in which it was necessary to treat ambulant patients Kulenkampff advises against the use of local anesthesia in acute cases My first patient was such a one operated in 1903 in a case of mastoiditis following typhoid fever I have since repeated the experience in a number of cases, and I am led to believe in consequence of this experience that it is in just such cases that local anesthesia finds its most gratifying field

When simple palliative drainage is desired, the preliminary infiltration need not be elaborate A simple line of infiltration over the most prominent part of the mastoid, followed by infiltration of the deeper parts from this primary line, permits a linear incision through the soft parts and an adequate opening of the cells for the purpose of drainage I have done this operation in a number of instances without removing the patient from

the bed The simple drainage tides over the emergency and the radical procedure can be deferred until the patient recovers from the primary disease

For the radical mastoid operation a more elaborate anesthetization is required I have ceased to employ local anesthesia when there is no contraindication to general anesthesia It may be employed with success, however, if one has plenty of time and the enthusiasm of youth The following plan has given me good service Beginning over the tip of the mastoid, a curved line is infiltrated, extending from the point of beginning to a point above the meatus This line may be half an inch or more

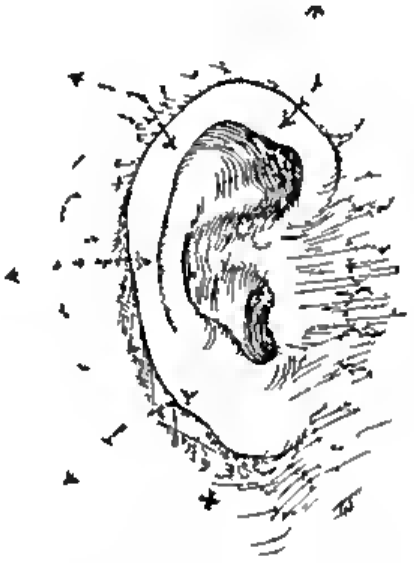

Fig 23 —The rings indicate the endermic infiltration and the arrows the direction of the deep periosteal infiltration in the radical mastoid operation The x indicates the point of exit of the facial nerve

from the ear (Fig 23) From the primary line the deeper parts are infiltrated by passing the needle forward and backward First, that below the skin infiltration is injected, and then the tissue on either side of this line The attachment of the sterno mastoid should be thoroughly infiltrated since this point is very sensitive Braun has shown that attempts at injection beneath the periosteum are unnecessary since the periosteum, together with the bone and cells, receives its nerve supply via the soft parts and is, therefore, effectually anesthetized by infiltration of the soft parts

From the point of beginning a line is now infiltrated in front of the ear to the point of termination of the line previously infiltrated back to the ear.

The skin of the meatus is now infiltrated by passing the needle behind the ear between the skin and the cartilaginous canal, and as much farther as possible (Fig. 24). The injection at this point must be very gently made or the expansion of the tissues by the anesthetic will cause excruciating pain. It is but momentary, it is true, but it is liable to upset the equilibrium of the patient. Care must be exercised at this point lest the needle

Fig. 24.—Points of deep infiltration into the auditory canal.

puncture the thin skin lining the meatus (Fig. 25). This error is made manifest by the escape of the fluid out of the external ear. By care the needle can be made to follow the desired plane for an inch or more.

From the auditory canal an additional injection is now made (Fig. 26) according to the suggestion of Neumann. The needle passes between the lining of the canal and the bone at the point of the beginning of the bony canal. By employing gentle pressure, 1 or 2 c.c. of the anesthetic fluid can be made to diffuse in this plane and reach as far as the tympanum. This membrane as well as the middle ear is anesthetized by this procedure. It

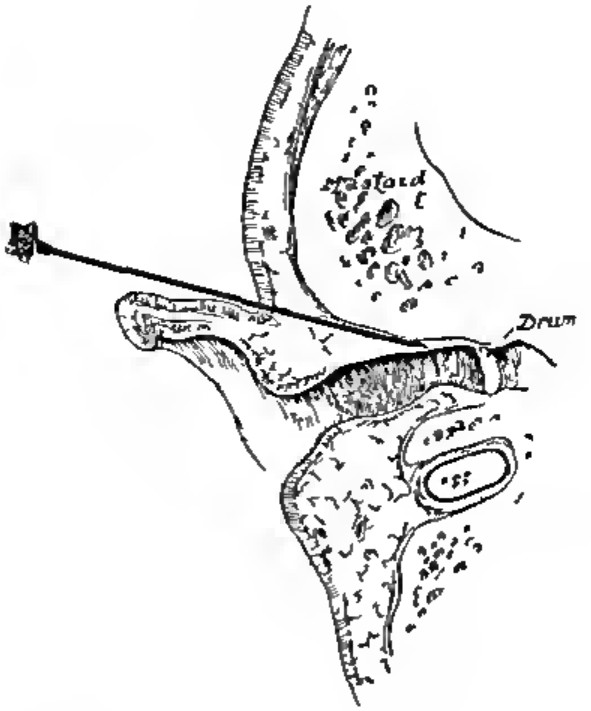

Fig 25.—Cross section of the auditory canal showing the passage of the needle between the bone and the soft parts of the tympanum

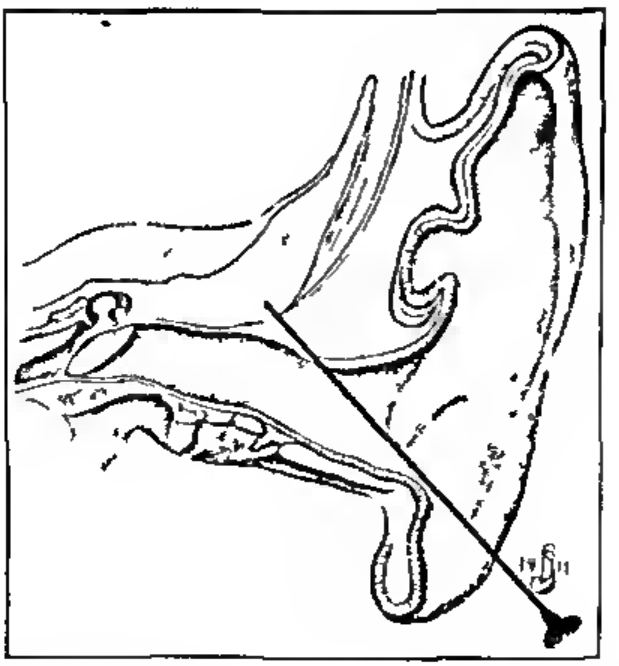

Fig 26.—Neumann's method of anesthetizing the tympanum

is imperative, let it be repeated, to employ for this purpose a syringe of small barrel caliber in order that a slow gentle expulsion of fluid will be possible

According to Possow this method of anesthesia is desirable for the removal of polyps, granulation tissue and the like because the operation is rendered practically bloodless

Kulenkampff advises against the use of local anesthesia in sinus thrombosis or temporal abscess I have found no contraindications in these diseases In fact, it is in just these cases that one is most anxious to avoid inhalation anesthesia Not infrequently patients are unconscious in these conditions and the problem of anesthesia is thereby simplified

Of course, the increased extent of exposure demanded by these operations must be anticipated by a corresponding extent of primary infiltration If the sinus is to be opened, care must be taken that a sudden gush of blood does not cover the face of the patient and frighten him In searching for temporal abscess, the trephine may sometimes be used to replace the chisel The jarring of the chisel is most likely to be annoying to the patient This may be lessened or obviated by using sharp instruments and proceeding slowly and making the cuts as obliquely as possible A water bag makes a more comfortable pillow for the patient than a sand bag or blanket

CHAPTER VII

INJECTION OF THE TRIFACIAL NERVE FOR NEURALGIA

A persistent endeavor has been made to inject the gasserian ganglion direct, either for the purpose of destroying it, or making possible its removal in neuralgia, or for the purpose of producing anesthesia in all its branches as a preliminary to extensive operation on the jaws. Theoretically the conception is beautiful, but practically the procedure is beset by many difficulties.

The chief interest in the trifacial nerve lies in the fact that it is possible to inject the various branches for tic douloureux. While cure is not attained, considerable relief can be secured by injecting alcohol into the nerve trunks. One may say that the first injection will secure relief for a year, the next injection possibly for six months. Subsequent injections are less certain. In most cases after a number of injections no results are obtained. On the other hand, relief may be obtained for a period of years. Aged patients may be made comfortable in some cases until they die of infirmities of age. Younger patients will ultimately require operation and should be so informed before the first injection is made.

Resection of the Sensory Root of the Ganglion

The gasserian ganglion was first removed under local anesthesia by Krause.[1] I have performed this operation with a fair degree of satisfaction but it is not a method of choice. It is easy enough to perform the operation up to the point that the dura must be elevated. However, the pain produced when the dura is elevated and the nausea that follows injection directly into the ganglion make the operation on the whole unsatisfactory. I have not attempted it for a number of years.

These patients are usually poor subjects for prolonged general anesthesia, and to do the operation under local would be desirable. I have tried using local anesthesia to the point where

[1] Centralbl. f. Chir. 39, 385, 1912.

the dura is to be raised and then proceeding to general anesthesia. When the general anesthetic is used, the wound, previously dry, begins to bleed at a myriad points, which makes it necessary to do the hemostasis all over again. I have not used this technic for a number of years.

Direct Injection of the Gasserian Ganglion.—The injection of the ganglion either with novocaine for the purpose of produc-

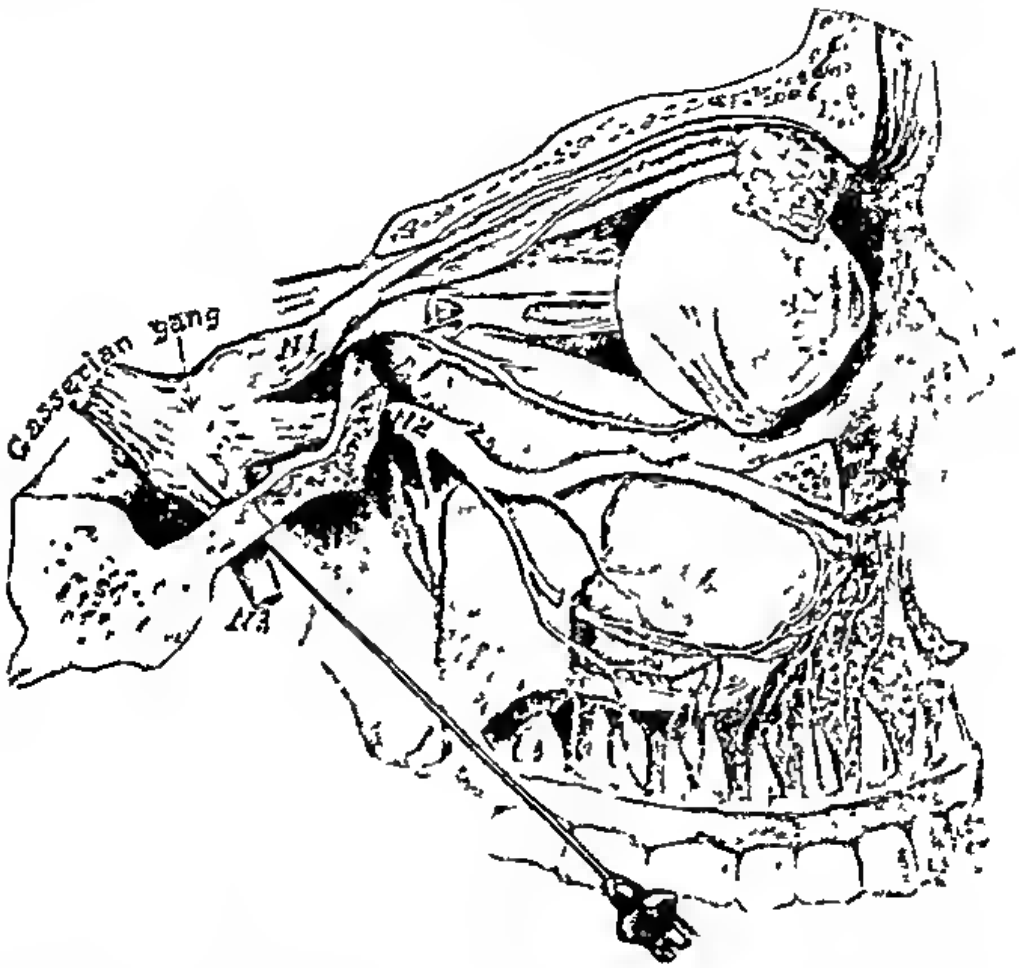

Fig. 27.—Method of passing the needle for injecting the gasserian ganglion The needle passed from the second molar tooth into the foramen (Adopted from Spalteholtz)

ing anesthesia for major operations on the jaws or with alcohol for neuralgia is too uncertain for the former, to make it an established procedure; for the latter, dangerous.

Operations on the Branches of the Gasserian Ganglion

While the operations for the removal of the ganglion and the injections into it for the production of anesthesia have not been

generally successful, both the injections of and the removal of the individual nerve branches have produced pleasing results Each branch may be considered in turn

Operations on the First Branch of the Fifth Nerve —This branch supplies the contents of the orbit and the region about it It passes along the lateral wall of the cavernous sinus and enters the orbit through the sphenoid fissure Immediately after entering the orbit it divides into its three branches Of these the lacrimal supplies the lids and the conjunctiva of the outer part of the eye and the skin of the forehead, the frontal nerve passes along the roof of the orbit and out through the supraorbital notch and supplies the skin of the forehead

Resection of the Supraorbital Nerve —This nerve is the only branch of the first division which is attacked surgically in the douloureux It is reached through an incision along the orbital border The orbital contents are pressed downward with a spatula and the nerve is exposed If a true foramen exists, or it is converted into a notch, the nerve is easily found The nerve should be cut off as far back as it can be reached and the peripheral portion twisted out as far as possible The most effective way to secure a severance far back is to use a nasal snare as recommended for the second branch This usually secures a longer piece of nerve than if twisting is depended upon as recommended by Thiersch On the whole operations on the first branch are unsatisfactory

Injections of the First Branch for Neuralgia —Injections of alcohol for the purpose of destroying the nerve must be confined to the point of exit at the supraorbital ridge If alcohol is injected into the orbit pronounced reaction results and undesirable scar formation may follow Injections are made as follows If a notch exists, it may be located by palpating along the bone with a needle until the foramen is found The needle is passed to just within the notch or foramen and some 10 minims of alcohol injected If the notch or foramen cannot be located, often the site of the nerve can be determined because of the sensitiveness of the nerve to deep pressure Alcohol may then be deposited about the nerve without an attempt to find the notch of the foramen

Resection of the Infraorbital Nerve—Infiltration is done for the operation as follows A point is selected a fingerbreadth lateral to the nose and twice as far below the orbital border The needle is passed upward and backward until the bone is reached The needle then searches until the point enters the foramen The needle is then passed along the canal as far as possible and the anesthetic solution deposited During this interval the operator may infiltrate a line along the lower border of the orbit and over the edge of the floor of the orbit This insures painless incision of the skin and isolation of the nerve The orbital soft parts should be elevated by a retractor and the infraorbital canal found by passing a small probe (a stylet from a spinal needle) into the infraorbital foramen The canal should be exposed by a small chisel and the nerve lifted out and injected as far back as possible, if there is any pain The nerve should then be fixed by a ligature and cut distally to it This gives an anchor to the portion of the nerve between the point of severance and the foramen rotundum A Jarvis, or similar nasal snare, is now threaded over the anchor string and segment of nerve and pushed back as far as possible The nerve is cut off, or the loop may be drawn taut and the nerve torn loose from the ganglion The distal part of the nerve should then be pulled into the cheek through the infraorbital foramen and windlassed out of the cheek as far as possible by winding about a pair of forceps

This operation is easily carried out and usually relieves the pain for a number of years

Injection of the Second Branch With Alcohol—One of the most useful procedures is the injection of the second branch at the infraorbital foramen This is best done by introducing the needle at the level of the nasolabial fold and a fingerbreadth lateral to the ala of the nose The skin is infiltrated with novocaine and the needle then passed upward until it touches the periosteum a fingerbreadth below the infraorbital ridge where a few drops of novocaine solution are deposited The foramen is then searched for When it is discovered, the needle readily passes into it for a depth of half an inch When this has been attained 10 or 15 minims of alcohol are slowly injected

Infiltration of the Third Branch—The third branch is no longer resected for neuralgia The operation is an extensive one, and the results of resection are no more permanent in neuralgia than injections of alcohol Anesthetization of this branch, therefore, is done only for extensive operations on the lower jaw and for neuralgias The nerve is located as for infiltration with alcohol, described below Several cubic centi

Fig 28—Direction of passing the needle from the middle of the lower border of the zygomatic arch toward the base of the mastoid process of the opposite side in order to reach the second branch of the trifacial nerve

meters of a 1 per cent solution are deposited in the nerve This method should not be employed for operations when there is infection of the cheek or face present Since most extensive operations are required for carcinoma, this method is not applicable when there are surface ulcerations Since few operations involve attack on the ascending ramus, such high anesthetization is not needed Blocking the nerve at the lingula

is entirely efficient, simpler and safer For all operations on the lower jaw blocking at the lingula is preferable

Injection of the Third Branch for Neuralgia—The needle is passed directly inward for a distance of 4 or 5 cm at the lower border of the middle of the zygomatic arch The pterygoid process will be encountered at a depth of 4 or 5 cm and should be grasped with a Kelley forceps flush with the skin The needle is then withdrawn until the point reaches the subcutaneous tissue and then reintroduced to an equal depth but in a direction slightly farther back The proper direction of the needle, according to my experience, is an imaginary line passing 2 or 3 cm above the mastoid process of the opposite side (Fig 28) When the needle reaches the depth at which it had previously touched the pterygoid process, it should be in contact with the nerve If the pain or paraesthetic sensations are not felt by the patient in the region of the distribution of the nerve, the needle may be cautiously passed a few millimeters deeper If the nerves still are not located, the point may be directed still farther back Patients do not always tell the truth and unless they volunteer the information but little dependence can be placed on their admission that they feel pain in the jaw or tongue When the nerve is located, 2 c c of 95 per cent alcohol are injected Alcohol of this strength is used because it will be diluted by the anesthetic solution in the tissues

Blocking at the Mental Foramen—In the neuralgias of the inferior maxillary nerve, without involvement of the lingual I prefer to block at the mental foramen This is easily accomplished by means of an ordinary hypodermic syringe The opening is just below the canine tooth The skin and soft parts are rendered insensitive with novocaine solution and then the foramen is searched for with the point of the needle When the needle enters it a cubic centimeter of alcohol is injected In normal individuals the foramen is at the mid point between the upper and the lower borders of the mandible In persons who have lost their teeth, the foramen is near the upper border, the alveolar process having disappeared following the removal of the teeth By this means the neuralgia is relieved for many months and by repeating the process at intervals these old patients may be kept comfortable

CHAPTER VIII

BLOCK DISSECTION OF CERVICAL LYMPH GLANDS AND OF THE BUCCAL SOFT PARTS

In the removal of the lymph glands of the neck local anesthesia finds one of its most satisfactory uses Complete block dissection is done with perfect anesthesia The adrenalin gives a relatively bloodless field, permitting the recognition of all important vessels when they are exposed and permitting double clamping The effect on the patient is surprisingly slight so that, so far as he is concerned, the operation is a minor one

The preliminary hypnotic as advocated for major operations is advised

A convenient incision for gland extirpation is one beginning at the point of the chin and extending backward beneath the border of the jaw beyond the angle Joining this line about its midpoint, one infiltrates a second incision along the anterior border of the sternomastoid (Fig 29) This line is infiltrated intracutaneously throughout its entire extent Through the horizontal line one infiltrates the loose tissue about the submaxillary fossa anterior to the sternomastoid It is well to deposit several cubic centimeters high up under the petrous process so that the tissues become edematized about the beginning of the inferior jugular vein This is usually the most difficult point of the operation Through the vertical line one injects the connective tissue lying over the sternomastoid muscle In this way one blocks the cervical nerves which are the chief supply to the lower part of this region The deep regions of the neck can be infiltrated by passing the needle behind the artery It is easy to locate the artery by palpation and thus avoid it This is best done by passing the needle behind the sternomastoid muscle, which brings the needle behind the carotid sheath and avoids the internal jugular vein No ill effects come from the deposition of the anesthetic solution about the pneumogastric nerve

When a large packet of glands is to be removed, as in tuberculosis or Hodgkin's disease, wherein the carotid is displaced

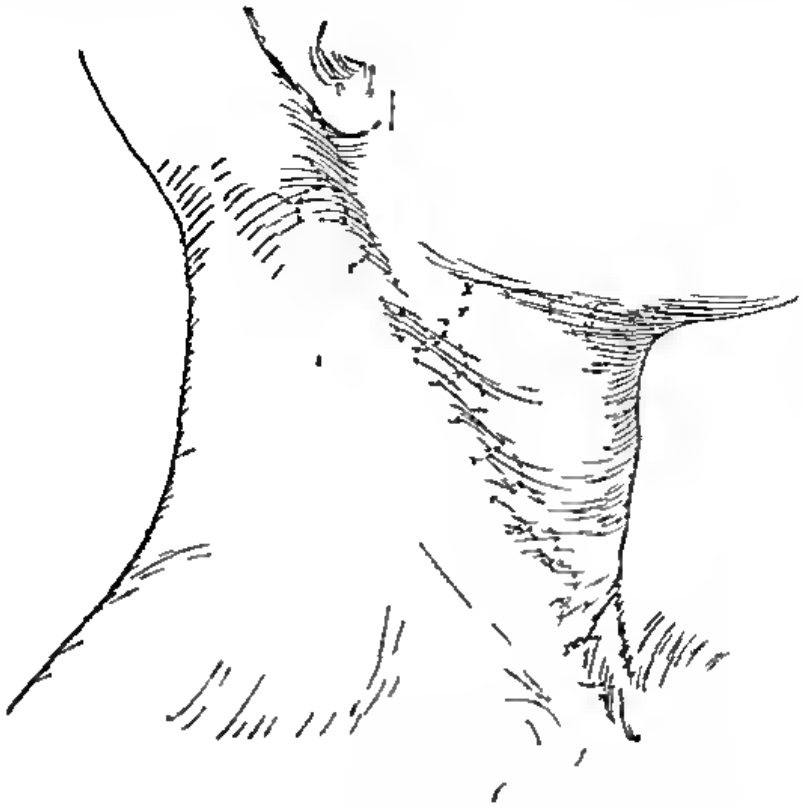

Fig 29—Line of skin infiltration for the removal of the cervical lymph glands preliminary to operation for carcinoma of the lips

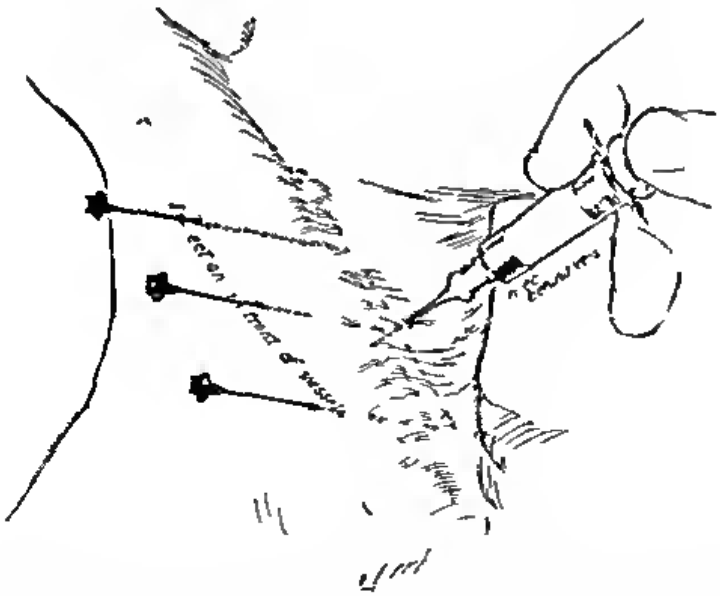

Fig 30—Points of deep infiltration in front of the carotid sheath and between the carotid sheath and the trachea in removal of the cervical lymph glands

outward, it may be advantageous to pass the needle in front of the carotid sheath (Fig 30) This has the advantage of bring

ing the anesthetic fluid directly into the field of operation The edema and vascular constriction so produced greatly facilitate dissection The tissue between the gland packet and the trachea should be infiltrated in order to make the patient less sensitive to traction upon the trachea By passing the needle lateralward and backward, the roots of the cervical nerves may be reached

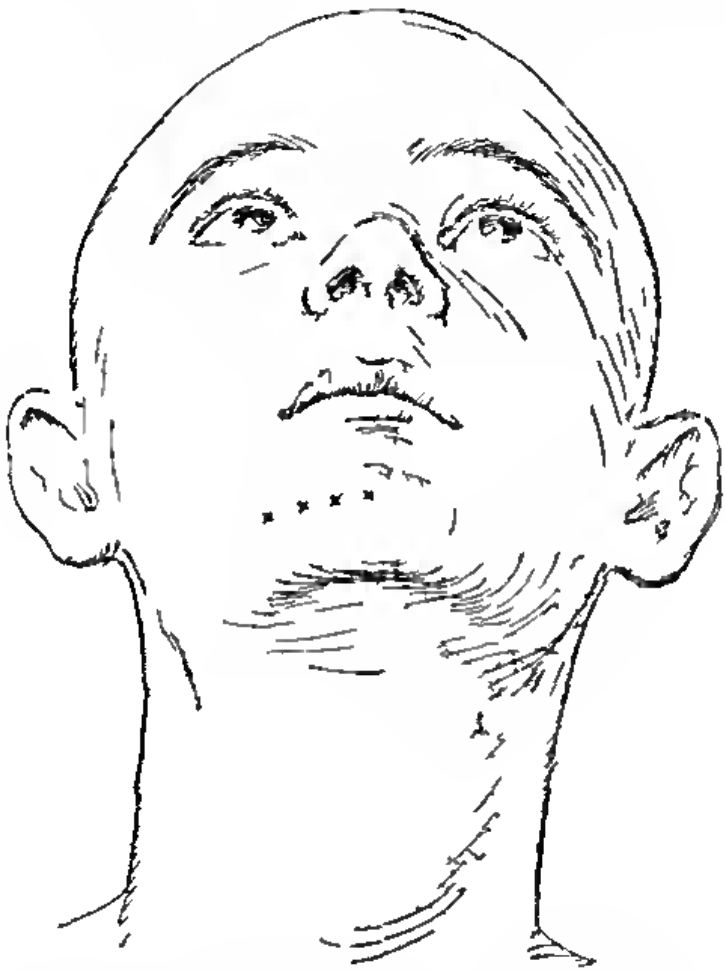

Fig 31 —Line of skin infiltration for excision of the lower jaw

Especially large tumors may require some modification of this technic If the tumor is fixed at any one point, this region requires special consideration

If in the course of the operation for the removal of densely adherent lymph glands the deeper tissues are found to be still sensitive when exposed, edematization by dilute solutions quickly reduces the sensitiveness The point likely to give rise to pain is beneath the base of the skull when the jugular vein

is ligated high up Should this region still be sensitive after infiltration as above advised, the tissues may be injected anew when this region is exposed at operation Undue anxiety on the part of the operator may cause him to include the vagus nerve in his ligature

The dissection is commenced below If the external jugular is to be removed, it should be isolated and doubly ligated Dissection upward is then easily and rapidly accomplished If any pulling must be done, it should be from below upward, because tugging laterally or downward transmits a pull to the pharynx and trachea and may give the patient a feeling of suffocation Blunt dissection should give way to sharp dissection, particularly when removing the submaxillary glands In fact, blunt dissection has no place anywhere particularly when operating under local anesthesia

A skin incision somewhat modified from that used in the removal of the cervical glands may be used to advantage (Fig 31) if the removal of a lip cancer is to be included in the operation This is the incision formerly employed for resection of the lower jaw At the present time there is no occasion for this operation having given way to conservative procedures It extends from the clavicle upward along the anterior border of the sternomastoid but passes near the parotid instead of over the mastoid process The deep structures are anesthetized as for the removal of the cervical glands At the level of the hyoid bone a second line extends inward and upward over the point of the chin From this line the mental foramen of the opposite side may be reached This incision gives good access to the tongue and floor of the mouth and permits the dissection of the entire region as well as the removal of the tumor

If the tumor is ulcerated, it is well to do the operation in two stages in order to avoid the infection of the neck wound

It is well to block the nerves at the lingula before the preliminary neck infiltration In addition, the mucosa in the floor of the mouth must be infiltrated

Operations on the Tongue

Limited lesions, such as cysts, can be excised under local infiltration More extensive lesions require blocking of the nerves

CHAPTER IX

OPERATIONS ON THE THYROID GLAND*

Local anesthesia is particularly desirable in goiter operations, it makes a bloodless field because it constricts the vessels, making it possible to pick up important vessels before they are cut and because the venous congestion usually associated with inhalation anesthesia is avoided Impending compression of the trachea is observed at once in the breathing of the patient and the gland can be manipulated so as to relieve the compression If the recurrent laryngeal nerve is approached, the patient manifests it by coughing or speaking in a husky voice There is rarely vomiting after local anesthesia, and pneumonia following its use is exceedingly rare When operating under local anesthesia, it is possible for the operator to perceive at once when the patient is beginning to weaken from the effects of the operation, he can then abbreviate his plans

Neural Anatomy—Fortunately the neural anatomy of the thyroid gland is simple because all the nerves are superficial, and can be easily blocked

Nerve Supply of the Skin and Muscles—The skin of the anterior surface of the neck is supplied by the superficial cervical nerves (Fig 33) These nerves are derived from the second and third cervical roots They pass first outward and backward and then curve about the posterior border of the sternomastoid muscle (Fig 34), and passing forward and at about the middle of this muscle between it and the jugular veins, perforate the platysma at the anterior border of this muscle and supply the skin covering the anterior surface of the neck.

The skin of the lower portion of the neck, at the site at which the usual collar incision is made, is supplied in part by sternal branches of the supraclavicular nerves These nerves pass behind the sternomastoid muscles, at a lower level than the preceding and reach the supraclavicular region after passing under the jugular vein The platysma is supplied by the lower

*A complete description of this technic will be found in the author's book on Diseases of the Thyroid Gland The C V Mosby Co St. Louis

branches of the facial nerves The sternomastoid muscles are supplied by branches from the spinal accessory nerve The sternohyoid and sternothyroid muscles are supplied by branches

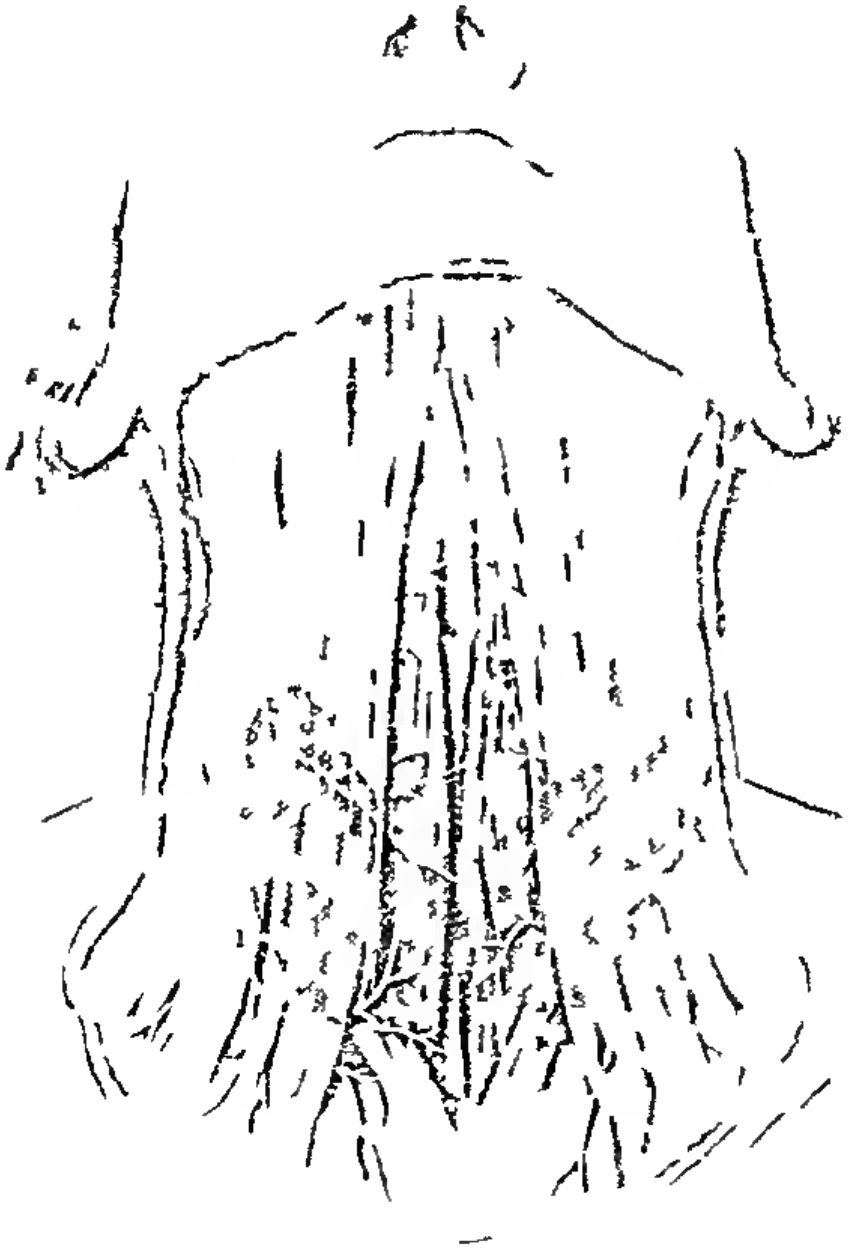

Fig —The fan shaped relation of the platysma muscle from the borders of the jaws to the clavicles is shown Between the medial borders of these muscles the sternohyoid muscles appear The cervical nerves lying between the sternomastoid and the platysma muscle pass downward and medially The relation of the thyroid gland to these structures is shown by the dotted figure

from the descending branches of the hypoglossal nerves and from branches of the first three branches forming the ansa cervicalis (Fig 34)

Nerve Supply of the Thyroid Gland—The nerve supply of the thyroid gland is more or less hypothetical Fortunately for

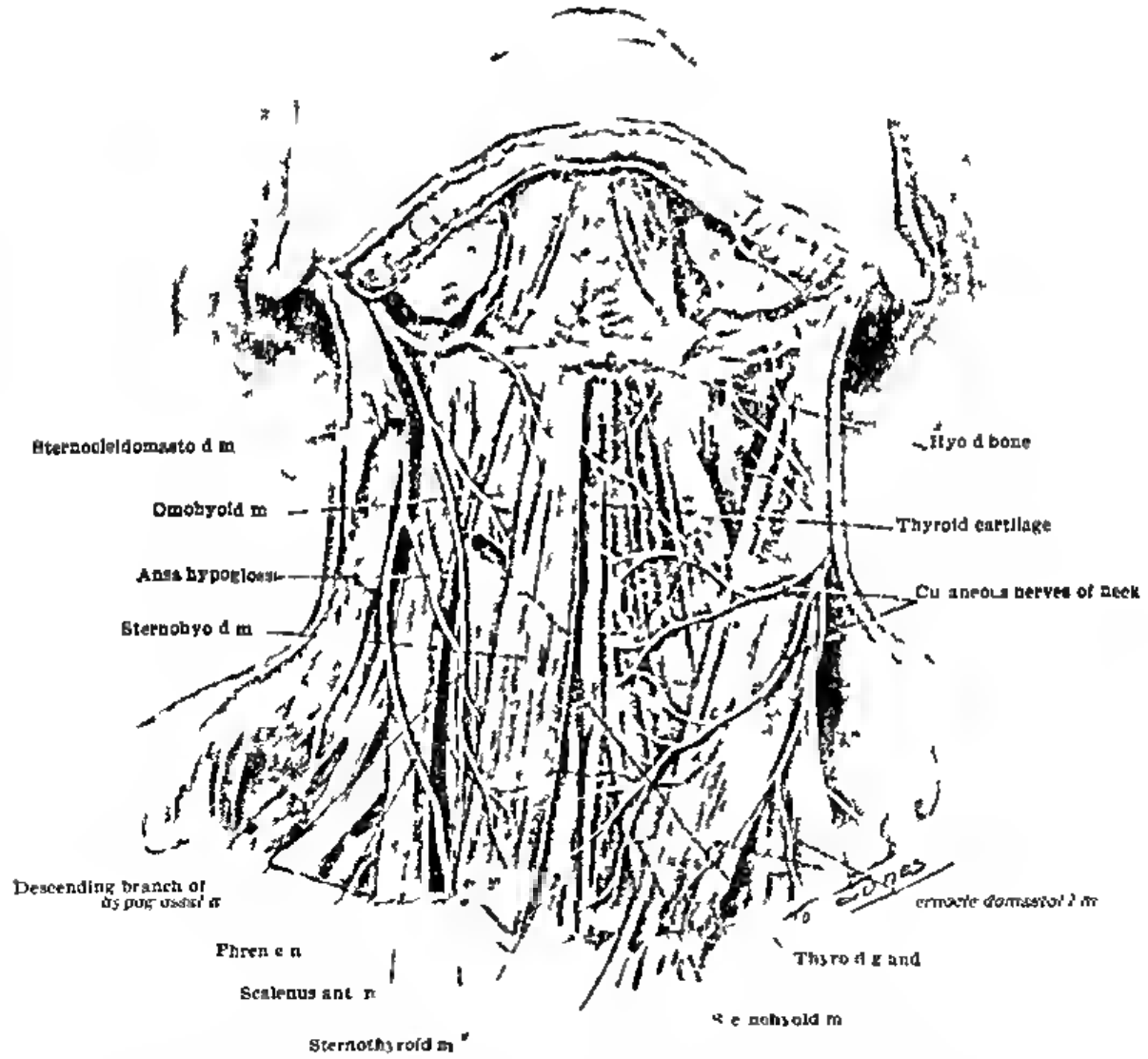

Fig 34—The nerve supply of the neck The anterior cervical nerves are seen on the right looping around the posterior border of the sternomastoid muscle and radiate medially and downwards These nerves supply the skin On the left of the figure the descending branches of the hypoglossal nerves are seen These nerves supply the deep muscles of the neck

the present purpose the nerves may be regarded as of little importance for the gland is but little sensitive Nerves undoubtedly reach the gland along the superior thyroid artery. They probably are derived from the second cervical ganglion

Fig 35.—Line of primary infiltration in the operation for goiter The lower wrinkle is selected as the site

Infiltration of the Skin.—A row of wheals is made along the line of the proposed incision which is usually along a fold of the skin just above the clavicles. (Fig 35.)

Infiltration of the Muscles—After the skin has been infiltrated, the platysma and the ribbon muscles should be infiltrated (Fig 36) It is easy to determine when the platysma has been reached by noting whether the point of the needle makes excur-

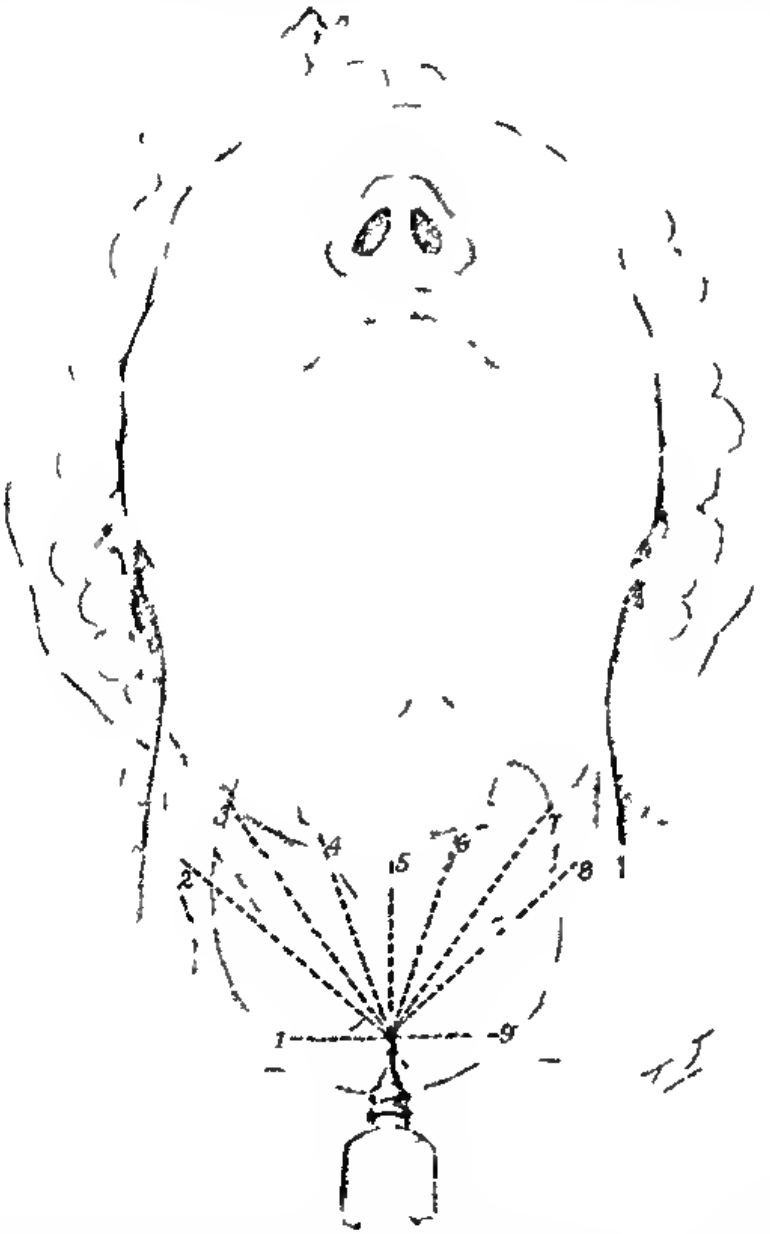

Fig 36—Intramuscular infiltration From the primary line of infiltration the needle is passed between the platysma and the more deeply lying muscles At *2* and *3*, and *7* and *8* the anterior cervical and the supraclavicular nerves are blocked. At *4* and *5* and *6* the pentracheal tissues are infiltrated The line *1—9* represents the primary line of infiltration (Fig 35)

sions when this muscle is moved. The deeper muscles must be approached with caution lest they be penetrated and the super-

ficial veins of the goiter be injured These muscles must be injected since they receive their nerve supply from above the descendens noni The medial border of the sternomastoid should be infiltrated as far as it will be necessary to separate it

Fig. Ier glandular nfiltrat on Tle needle pi e l between the gland and the o erly ng n u c e By pre ng o er the soft parts as the needle s being passed the po nt may be made to reach the pace between the trachea and superior pole of the g and A l ke n aneuver at other parts of the gland makes it po s ble to infiltrate the ent re per glandular t s ne

from the underlying structures When this step is being done, it is convenient to pass the needle outward and upward until the

point comes to lie at the outer border of the sternomastoid between this muscle and the platysma Solution injected here will block the cervical nerves at the point where they wind about the muscle

Infiltration About the Gland—It is convenient at this point to infiltrate the connective tissue capsule surrounding the gland This not only anesthetizes any point which has escaped the pre

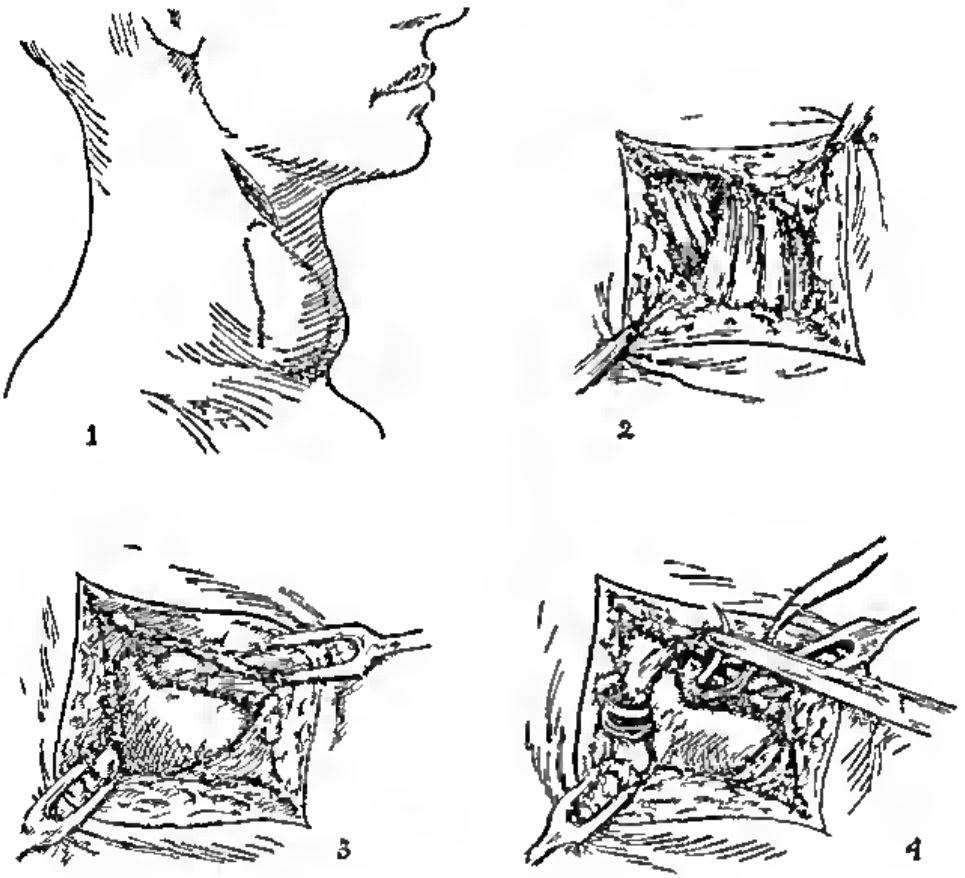

Fig 38—Technic for the pole ligation *1* site of the incision *2* deep muscles exposed *3* upper pole of the thyroid gland with its vessels *4* a needle carrying a silk ligature is passed eye first

vious injections, but greatly facilitates the enucleation of the gland by lessening the bleeding and making the facial planes stand out more clearly This is best done by passing the needle over the gland between it and the overlying muscles It can be done by describing radiating lines from the original point of infiltration (Fig 36) When the gland is large it may be necessary to slide the overlying structures about in order to reach all

points The point between the upper pole and the trachea should receive especial attention since this is the point where separation from the trachea must be made in ligating the superior pole The needle can be made to enter deep here by pressing on the soft parts with fingers of the left hand (Fig 37)

During the course of the operation sensitive points about the surface of the gland may be infiltrated from time to time This is particularly desirable in acutely enlarged glands and in those which have been subjected to the actinic ray

Infiltration for Pole Ligation—A line of skin is infiltrated along one of the skin folds under the angle of the jaw The deep muscles are then infiltrated and finally the deep tissues about the tip of the upper pole of the gland

CHAPTER X

OPERATIONS ON THE TONSILS, LARYNX, AND TRACHEA

In operations on the upper respiratory tract local anesthesia finds one of its most useful fields Tonsillectomies present about the simplest possible problem in local anesthesia

In operations on the larynx and trachea local anesthesia is distinctly the choice It makes the area relatively bloodless, the secretions can be expelled by the patient himself, and the anesthetist and his apparatus are eliminated A preliminary tracheotomy is unnecessary, and the danger of aspiration pneumonia is materially lessened Because of the bloodless field it gives, even the major operations in this region are simplified

Operations on the Tonsils

In young children general anesthesia is still required for the removal of tonsils In older children and in adults the use of a general anesthetic is an unnecessary infliction on the patient The technic of tonsil removal is made vastly easier under local anesthesia because the upright position enables the operator better to observe the relation of tonsil and pillars, and the bloodless field further simplifies the operation enormously

A preliminary spray with cocaine or a hypodermic of a moderate dose of morphine and atropine lessens the reflexes and is desirable in nervous persons but can be dispensed with in all cases

Novocaine epinephrine is the anesthetic of choice Some laryngologists still use cocaine, but the dangers of this drug are such that its use is unwarranted since novocaine gives perfect anesthesia in quantities far below the safe maximum A few drams of a one half or, at most, a 1 per cent solution which contains a minim of adrenalin to the dram is quite sufficient for any operation

The solution is injected about the capsule of the tonsils with or without preliminary swabbing of the surface of the pillars

The needle is passed through the pillar as indicated in Fig 39 Two or more points should be infiltrated The distance from the edge of the pillar at which the needle is made depends on the type of tonsil In submerged tonsils the injection must be made farther from the edge of the pillar At least one point of injection should be made lateral to the body of the tonsil which must reach the peritonsillar tissue lateral to the capsule of the tonsil and one at the upper pole and one at the lower pole

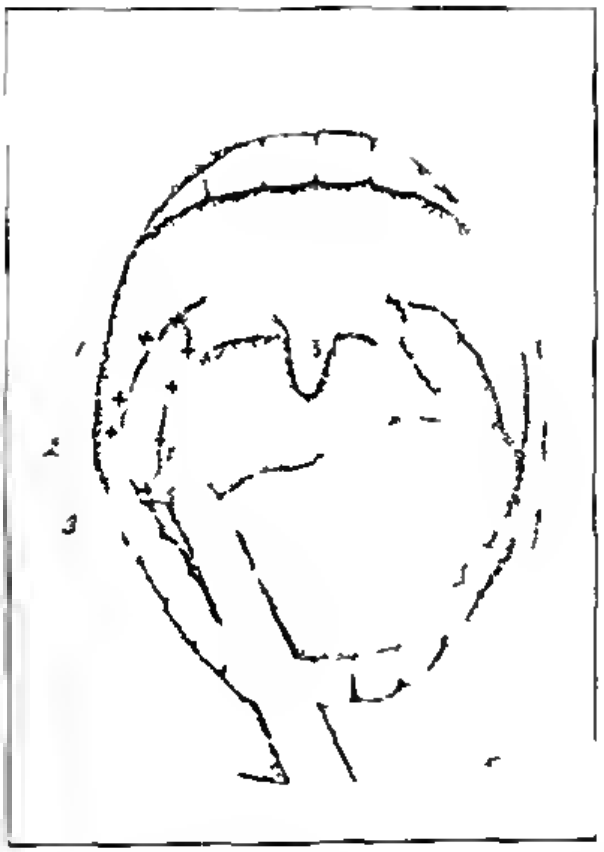

Fig 39 —Anesthetization for tonsillectomy The points 1 2 3 at least should be injected Additional points may be injected with advantage in markedly adherent tonsils

This latter injection is the most important and is the one most difficult to make Tonsils frequently project deeply down beneath the pillars toward the root of the tongue The injection must reach below the tonsillar tissue If this is done the pain complained of when it is not done when the snare is tightened, will not be experienced The posterior pillar may be injected, but this is not necessary if the lower pole has been injected as above indicated

Both tonsils should be injected before the operation is begun because the tonsil first injected is being acted upon by the anesthetic while its fellow is being injected and the operation may be begun on the tonsil first injected as soon as the infiltration of the second is complete

If the operation is done carefully the operator can note whether a vessel of any importance is cut during enucleation This is important for if it is encountered, it may he ligated without delay If attention is given to detail, late bleeding is no more likely to occur than when the operation is done under general anesthesia

Laryngotomy

The need for the splitting of the thyroid cartilage usually arises because of the presence of some intrinsic laryngeal tumor

A line of skin three inches long is infiltrated The mid point of this line should fall below the Adam's apple From this line the subcutaneous tissue over and to either side of the trachea is infiltrated (Fig 40) The space between the upper pole of the thyroid gland, if it is palpable, and the trachea should be infiltrated (Fig 41) The needle should be then passed still higher until the level of the top of the thyroid cartilage is reached and this area is well infiltrated This blocks the superior thyroid nerve Theoretically if the needle is passed too deeply there is danger of blocking the pneumogastric nerves Since these nerves lie deeply behind the superior thyroid nerves, the danger is negligible I have never paid any attention to this alleged danger, and I have never encountered the slightest difficulty

After the infiltration above indicated has been completed, an incision is made down to the cartilage The cartilage should be exposed for a short distance on either side of the midline (Fig 42)

From the midline the submucous space is injected The needle is passed just through the cricoid membrane in such a manner that the bevel edge of the needle lies parallel with the plane of raw mucosa (Fig 43) Care must be taken lest the mucosa be punctured The injection of 0 5 cm of the anesthetic fluid is made very slowly If done slowly the fluid diffuses in the submucous tissue without exciting any reflexes A point

higher up is likewise injected. This point should reach the level of the cords. A slightly larger amount of fluid is deposited here.

If the injection has been properly done, no reflexes will be excited when the interior of the larynx is exposed. Should an irritable area be discovered in some part, it can be subdued by pressing a pledget of cotton, moistened in cocaine solution, against it

Fig. 40.—The circles represent the endermic wheals made by the injection of the solution. The arrowed radiating lines show the direction the needle is passed when the tissues lying between the skin and trachea tissue are being infiltrated.

Tracheotomy

It is not necessary to block the superior laryngeal nerves in a simple tracheotomy and if there is need for haste, the anesthetization of the mucosa is omitted. In its simplest form, therefore, tracheotomy consists in the anesthetization of the skin and subcutaneous tissue followed at once by the incision through

the skin, the clamping of the vessels and the continuation of the incision through the subcutaneous tissue, the cartilage and the mucosa and the introduction of the tracheotomy tube

Laryngectomy

The removal of the larynx is a more formidable procedure than either of the preceding operations, but it is best done under

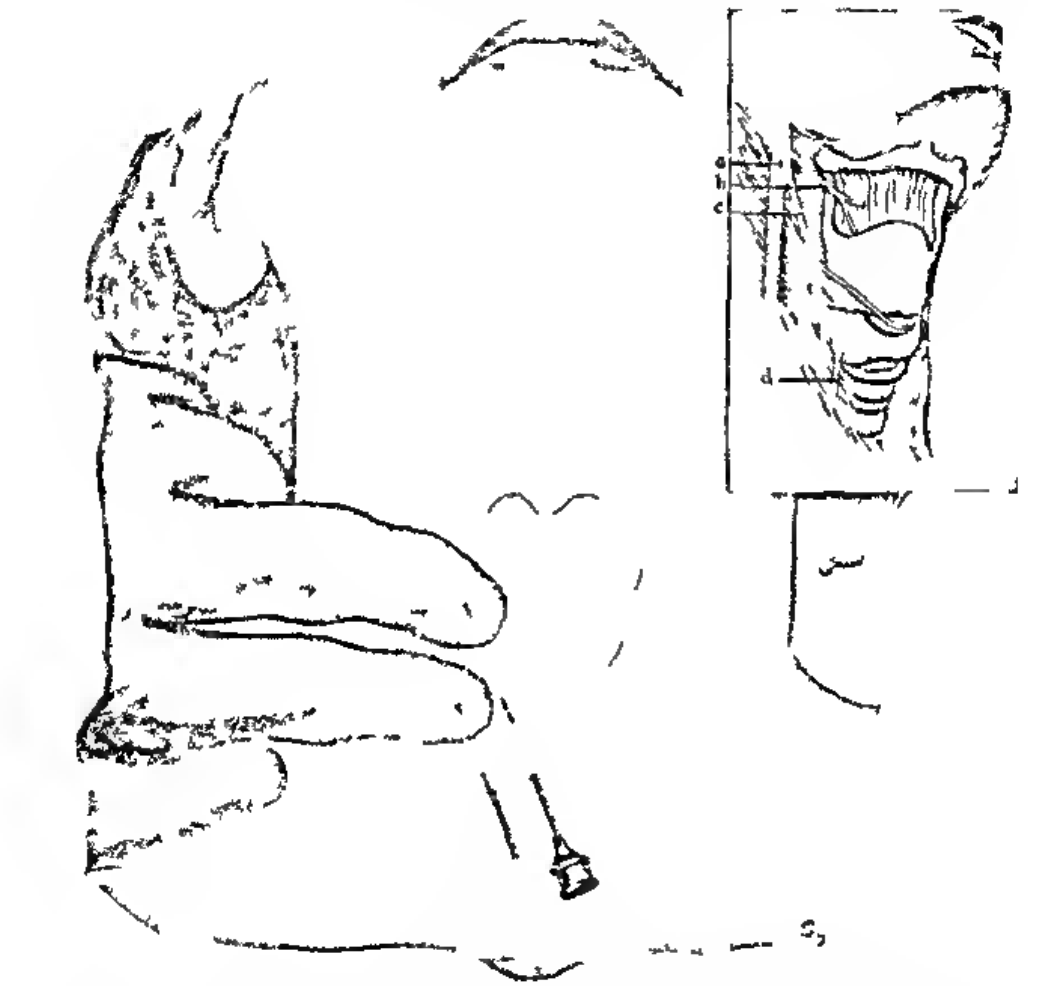

Fig 41.—Deep infiltration about the larynx to block the superior laryngeal nerve *Insert* *a* the pneumogastric nerve *b* the internal laryngeal branch *c* the external laryngeal branch *d* the recurrent laryngeal nerve which does not require blocking

local anesthesia It is desirable in these cases to use a larger amount of preliminary hypnotic than for most operations As much as $\frac{1}{100}$ of a grain of hyoscine and $\frac{1}{3}$ of a grain of morphine may be advantageously used before the operation, preferably given in two doses, two hours and one hour before the opera

tion begins If the patient is much reduced a $\frac{1}{150}$ grain of hyoscine and $\frac{1}{4}$ of morphine should not be exceeded

The primary line of infiltration extends upward to above the hyoid bone and below to the third tracheal ring The tissue about the trachea and thyroid cartilage is more completely infiltrated than for thyrotomy and by moving the larynx from side

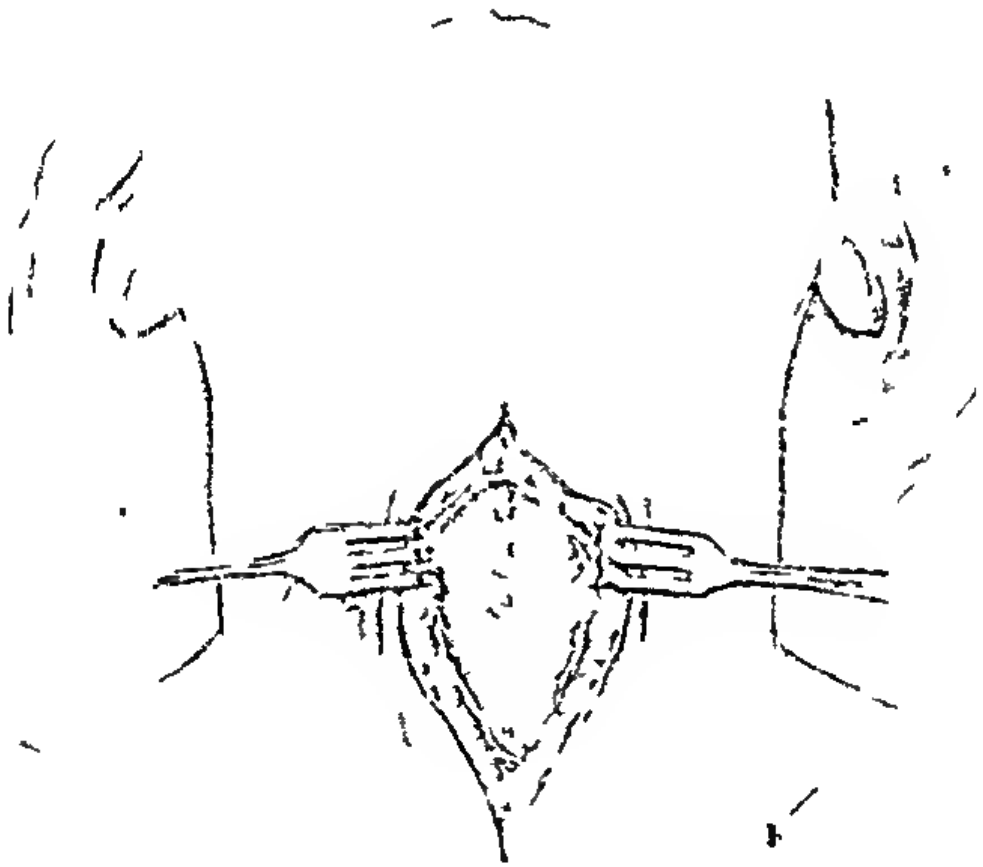

Fig 42—The soft parts have been severed and are held apart by retractors exposing the cricothyroid membrane and the thyroid cartilage The dotted line shows the site of proposed incision

to side the postpharyngeal tissue is infiltrated as much as possible Particular care is required that the superior laryngeal nerves are well infiltrated This is done in the manner described for thyrotomy The sternohyoid and hyothyroid muscles likewise are infiltrated

The incision is then made down to the cartilage and the muscles are separated near their insertion If they are still sensitive, they may be injected anew After the muscles have been severed, the larynx may be pulled forward and the mucosa of the pharynx injected as well as the constrictor muscles The

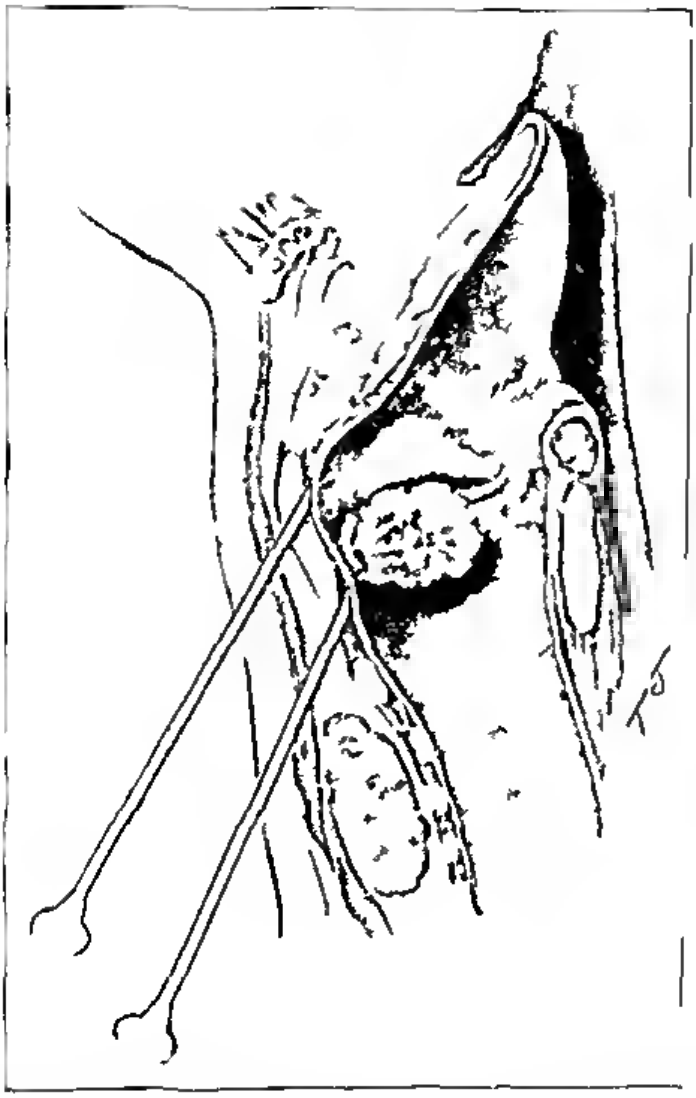

Fig 43.—Schematic diagram of a cross section of a larynx The needles are pressed obliquely through the soft parts and through the cricothyroid membrane and the thyroid cartilage The tip of the needle is halted the instant it passes through these structures It then lies between these structures and the laryngeal mucous membrane The anesthetic fluid is deposited here Note that the beveled edge of the needle lies upon the parallel to the deep surface of the muco

operation may then proceed to completion The upper end of the trachea after so much infiltration has been done, may be

severed without causing pain If the respiration is not interfered with, I prefer to separate the larynx above before severing the trachea If the respiration is disturbed, the trachea may be severed at any stage of the operation If there are any palpable glands in the drainage area (at the region of the bifurcation of the carotid) these must be removed before the trachea is loosened

CHAPTER XI

OPERATIONS ON THE MAMMARY GLAND

Novocaine adrenalin is the anesthetic of choice in all benign lesions of the mammary gland Because of the elastic character of the connective tissue of the breast, considerable pressure on the piston of the syringe is needed to force the fluid into the breast

Because of the great extent of the wound required in the radical removal of the breast and the diversified nerve supply of this region, this operation does not lend itself readily to performance under local anesthesia Nevertheless, the radical operation may be satisfactorily done if there are definite contraindications to general anesthesia In thin women this is readily accomplished, but in fat, muscular patients the tax on the operator's time and resources is greater than in any other operation It is in just these women that a particularly radical operation is required Fortunately, in this type of patient there are seldom contraindications to general anesthesia In thin, aged, feeble women in whom the indications for local anesthesia are generally met, the operation offers no great difficulties With increasing experience I feel less and less inclined to do breast operations under local anesthesia The labor entailed is so great that it is out of all proportion to the slight inconvenience saved the patient It is a stunt for the young man developing his technic rather than for the experienced operator who has ceased to thrill at the unusual

Nerve Supply—The skin in the region of the mammary gland receives branches from the cervical plexus through the sternoclavicular and acromial nerves together with some twigs from the intercostal nerves The breast itself is supplied by branches from the fourth, fifth and sixth intercostal nerves None of these nerves admits of blocking at its source Therefore, infiltration about the field of operation must be depended upon

Opening of Abscesses

Chronic abscesses of the breast may be opened by simple infiltration of the skin in the affected area Acute abscesses are so wide in extent and the parts so sensitive that no form of local anesthesia is satisfactory Here gas or ether rausch finds an ideal application

Benign Tumors

The entire adenofibromatous and mixed tumor group is readily managed under local anesthesia When the tumor is small a simple line of infiltration over the summit with infiltration beneath makes its removal a simple matter With large tumors one makes a circular infiltration about the base and then by means of a long needle infiltrates the tissue between the tumor and the chest wall (Fig 44) In this manner the tumor may be removed with more or less of the breast tissue

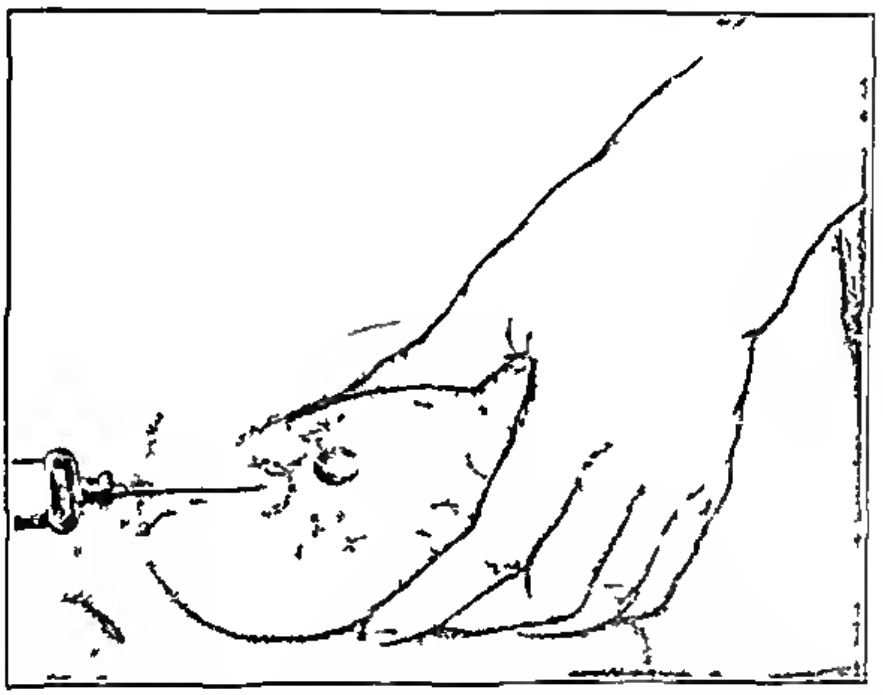

Fig 44 —Infiltration about a benign breast tumor with infiltration between the tumor and the surrounding breast tissue (modified from Braun)

When a portion of the breast is to be excised, the breast tissue itself about the lesion to be removed must be infiltrated The breast tissue, particularly in interstitial mastitis is so elastic and rubber like that infiltration is difficult The needle enters with difficulty and the fluid diffuses but slightly Great patience, therefore, is required in this stage of the infiltration

Diagnostic Incision in Senile Parenchymatous Hypertrophy

The most difficult problem in breast tumor surgery is the differentiation between the malignant and the benign states of the breast in women at or near the menopause, when the breast is

more or less hypertrophied At this period it is advisable to infiltrate the entire breast area so that if desired a part or all of the breast may be removed

An ellipse may be infiltrated about the nipple or a simple curved line about the lower border of the breast (Fig 45) When the lesion is localized and the *question is one of local*

Fig 45—Line of infiltration for diagnostic incision of the breast This line may be made in the fold so that the resulting scar will be hidden by the overhanging breast

hypertrophy with or without cyst formation, the elliptical infiltration in the skin may be followed by an elliptical infiltration of the mammary gland itself As already indicated, the gland, particularly when the interstitial tissue is increased, is a difficult tissue *to infiltrate* *Syringes with narrow* barrels will be convenient here The "feel" of the tissue to the needle alone

is sufficient to differentiate between malignant and non-malignant foci in many instances. When the area of involvement is more diffuse, a single long semilunar line of infiltration along the lower border of the breast is most convenient (Fig. 45). From this line the tissue between the breast and the skin and between the breast and thoracic wall must be infiltrated. This is readily done by sliding the breast about beneath the skin

Fig. 46.—By sliding the skin over the breast the area may be infiltrated without puncturing unanesthetized skin

(Fig. 46). The incision is then made through the skin down to the gland and the inferior edge of the gland is exposed. The gland is then loosened from the thoracic wall and tilted upward, exposing the lower surface. The gland may now be cut into and a search made for malignant areas. With the breast so exposed, however, the "feel" of the breast to the finger and to the knife

will leave few cases in which there is any doubt If it is not malignant, a part or all of the gland may be excised and the operation terminated

If a malignant focus is discovered ether had best be given and the operation terminated in the usual manner It is my practice in cases in which there is a suspicion of malignancy to state to the patient that there is probably no malignancy, but that an exploratory incision under local anesthesia will settle the matter The patient is told that if no malignant area is discovered the suspected area only will be excised, but should malignancy be encountered, ether will be given and the operation performed in a radical manner With such an understanding many women consent to the definite solution of their problem who would hesitate to accept without parley a more radical procedure

The objection raised against breast explorations under local anesthesia is that if the operation turns out to be more extensive than was at first expected, an incomplete operation results The indictment is against the operator It implies that he is unable to foresee the possible extent of the operation or that, seeing the requirements, he has not the courage to fulfill them If he will in every instance bear in mind the possibility that a radical operation may be required and be fully prepared to meet it, no expenditure of courage will be required to meet the indication

The Radical Breast Amputation

As already stated, this operation may be performed under local anesthesia on any kind of patient Because of the labor entailed, I volunteer it only in women with pulmonary or cardiac diseases and in slight, elderly persons

In feeble persons with ulcerating mammary cancers with metastases making cure impossible, the patient may be made more comfortable by a simple mastectomy This is easily accomplished by infiltrating an ellipse about the border of the breast and from this line infiltrating the submammary tissue (Fig 47)

The radical operation is begun by making an ellipse about the lesion including the nipple, as in mastectomy (Fig 47), circumscribing the extent of skin it is deemed necessary to sacrifice

This ellipse is extended along the lower border of the pectoralis major to the axilla thence down the bicipital groove and upward just below the clavicle (Fig 47) Infiltration in the region of the clavicle is made extensively for it not only anesthetizes the skin but blocks the sternoclavicular and acromial nerves

From these primary lines the deeper tissues are infiltrated both about and beneath the gland about the brachial vessels

Fig 4 —Lines of infiltration for radical operation upon the breast The ring line indicates the skin infiltration and the arrow lines indicate the direction of the deep infiltration. The lines reach the pectoral fascia

and into the tendons of the pectoral muscles and by passing the needle through these tendons the loose tissue beneath them is reached

Even with abundant infiltration of the axilla the operator must be on the look out for the long thoracic the intercostohumeral and the axillary nerves for the weak solution above recommended injected into the loose tissue of the axilla will

not anesthetize these relatively large nerves They should therefore, be blocked by infiltration directly within their sheaths They may then be avoided or resected as the operator's temper prompts him

The operator need not deviate from the type of operation he is accustomed to perform I prefer to allow the pectoral muscles to remain The tendons may be severed to facilitate dissection, and subsequently reunited The removal of a wide area of skin, it seems to me, is the most vital factor in this operation and the removal of any extent is easily accomplished In fact, the removal of skin coextensive with the breast area facilitates the infiltration of the retroglandular tissues and therefore encourages a radical procedure in this part of the operation

Many of the late recurrences in the skin can be removed under local anesthesia There is often much scar tissue about these recurrent nodules, and it is therefore necessary to infiltrate extensively about them in order that the nerves may be blocked before they enter the scar area

CHAPTER XII

OPERATIONS ON THE THORAX, LUNGS AND SPINE

When one considers the state of the patients demanding operation for empyema and lung abscess, it is readily understood that in no class of operations is a general anesthetic more often contraindicated The displacement of the heart in intrathoracic accumulations, the embarrassment of respiration and the general septic condition of the patient, all make inhalation anesthesia hazardous

The demands on the resources of the operator in doing these operations under local anesthesia are sometimes great, though fortunately the majority of operations are simple Simple rib resection requires little skill, the drainage of lung abscess decidedly more and complex rib resections with the associated scar formation may try the skill of the most experienced

Neural Anatomy—The skin in the region of the spine and the subjacent muscles are supplied by the primary dorsal division of the spinal nerves These nerves also supply the deep muscles of the arch and likely supply twigs to the lateral portion of the spinal dura The lateral and anterior portions of the thorax are supplied by the intercostal nerves These represent the anterior division of the thoracic nerves (Fig 48) They travel, in the first part of their course, immediately beneath the parietal pleura In the axillary line they pierce the internal intercostal muscle and travel in the space between the two muscles to near the sternum About the middle of their course they give off a cutaneous branch which supplies the skin in the lowest part of the chest, while in the upper part of the chest the clavicular and acromial nerves supply the skin The nerves terminate over the sternum and supply the skin in this region

The parietal pleura also is supplied by these nerves as is the outer two inches of the diaphragm The remainder of the diaphragm is supplied by the phrenic

Operations Upon the Spine

Because of the danger or embarrassment to respiration likely to ensue when operating upon injuries to the vertebra in the upper dorsal region, local anesthesia is particularly to be desired The depth of the object of the attack furnishes the chief

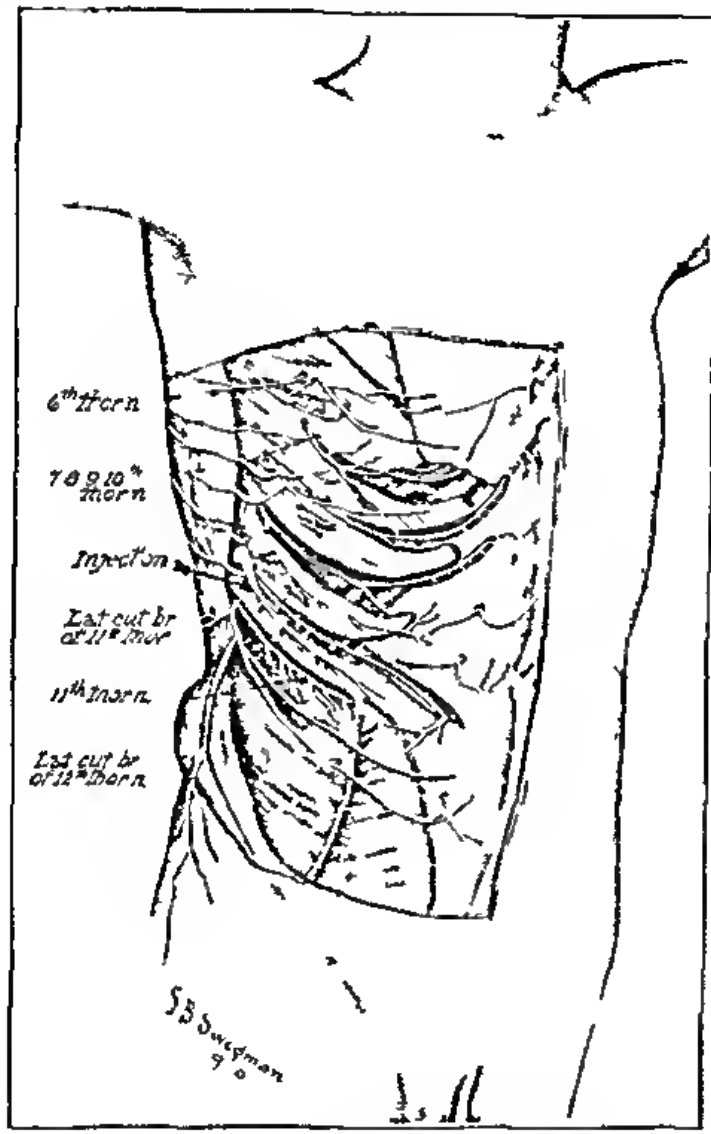

Fig 48 —Nerve supply of the abdominal wall

difficulty The physical build of the patient permits us, therefore, to predict the difficulties to be encountered The freest access possible must be the aim This may be achieved by infiltrating with novocaine epinephrine six inches over the spinous process in the region affected Through this line the muscles

about and lateral to the spinous processes are extensively infiltrated with a weak solution of novocaine epinephrine. This

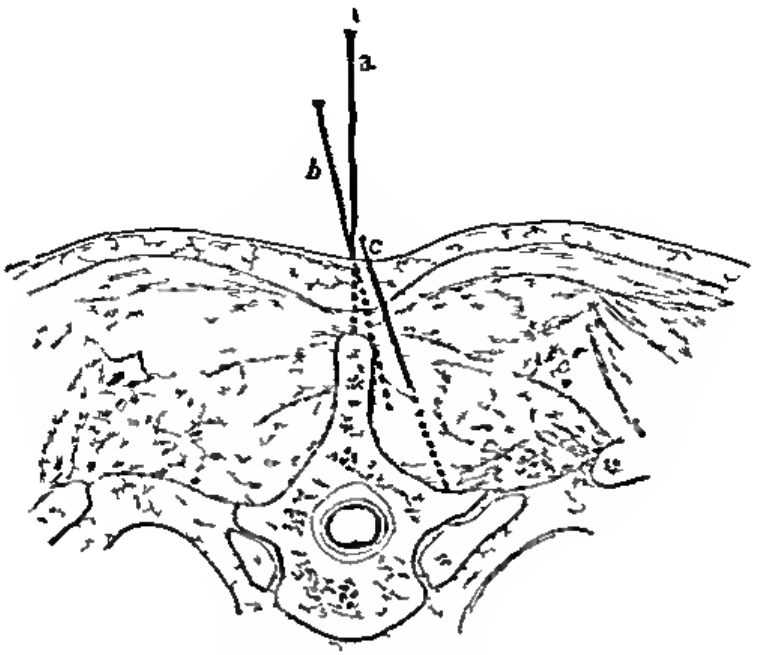

Fig 49.—Infiltration of the deeper layers in laminectomy

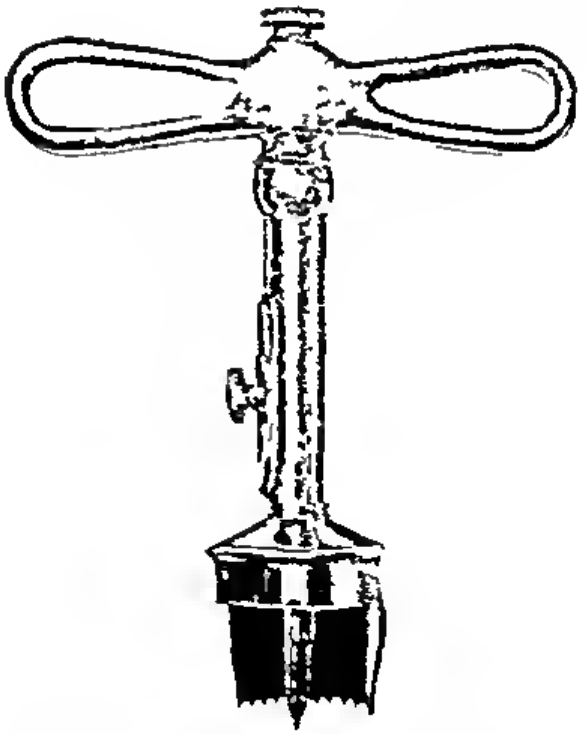

Fig 50.—Author's laminectomy trephine. It is made by removing three-fifths of the cutting edge of an ordinary 1¼ inch trephine

blocks the posterior root of the thoracic nerves (Fig 49), and the action of the epinephrine secures a relatively bloodless field.

The needle should be gradually pushed forward until the liga ments are reached These can be infiltrated without injuring the cord The usual operations may then be performed, since, like the dura of the brain, posterior portions of the dura of the spinal cord as well as the cord itself is not sensitive

As in the operations upon the skull the patient may be an noyed by the manipulation of the bony parts For this reason the chisel must be eschewed and cutting forceps substituted A large, powerful Dahlgren forceps is most suitable In order to avoid even so much jarring I have devised a trephine for cut ting the arches (Fig 50) The spinous processes are removed and the arches are then cut first on one side and then on the other with the modified trephine When both sides have been cut, the arch may be lifted out This method has the advantage in that the spinal roots are not interfered with, as is often the case when cutting forceps are used When the requisite num ber of arches have been removed, the dura and cord may be manipulated without annoyance to the patient

Thoracentesis

The correctness of the clinical diagnosis must be proved by exploratory puncture Preparation for the treatment required should be done at the time of the exploratory puncture, for it saves the patient a second annoyance and the surgeon a second preparation The clinical diagnosis should be sufficiently accu rate to determine the character of apparatus which will be re quired If the exudate is serous, an aspirator alone is required, if purulent, the necessary apparatus for a permanent drainage must be at hand The exact point where fluid will likely be ob tained is determined by physical examination A tract for the aspirating needle, in case aspiration alone is needed, is anes thetized with a small needle This done, the larger needle is introduced, the interval between the puncture and the aspiration permitting perfect anesthesia to take place Freezing effec tually prevents pain in the skin from the initial prick, but the effect is evanescent and it is followed by after pain Salt and ice pressed against the skin for a minute or two lessen the sen sibility to a considerable degree Neither of these methods pro duces an anesthesia lasting long enough to permit careful ex

ploration Injection anesthesia is, therefore, preferable because it not only permits the operator to study the character of tissue through which the needle passes, but if therapeutic measures are to follow, the operation may proceed at once Ten or twenty minims of 1 per cent novocaine epinephrine solution are drawn into the syringe, a fold of skin over the intercostal space in which the puncture is to be made is caught between the thumb and forefinger so that it becomes anemic and thus less sensitive The needle is made to penetrate the skin at a slight angle and a few drops of the fluid are deposited in the skin The needle is then gradually forced inward immediately above the next rib below in order to avoid the intercostal vessels which lie in the groove of the upper rib As the needle reaches the pleura, the resistance is increased or the patient experiences slight pain The remainder of the anesthetic fluid in the syringe is deposited at this point An interval of a few seconds permits anesthesia to become effective and the needle may then be pressed into the pleural cavity, whereupon the resistance is suddenly lessened The syringe is then steadied with the left hand while the right gradually withdraws the piston If fluid is present, it should appear in the barrel of the syringe If no fluid appears, either it is absent or the needle may be too short to enter the thoracic cavity, or the fluid may be too thick to pass through the needle If no fluid is present, the needle can be felt to strike the visceral pleura and usually the patient complains of pain If there is doubt about the needle entering the cavity, a longer one should be employed If the physical findings for fluid are definite and the case is of long duration, the possibility of a fluid too thick to pass the needle must be entertained and a needle of larger caliber employed Adhesions at the site of puncture may give a negative aspiration In that event the same procedure must be repeated in other likely situations If the site of an adhesion is punctured, the needle enters the lung, which is manifest by the entrance into the syringe of bubbles of air covered with blood

In the absence of more suitable apparatus a syringe holding a few drams and fitted with a stopcock may be employed It is a slow method and is trying to both patient and operator, but

it is possible to remove large accumulations with this simple apparatus A suitable apparatus is the Potain aspirator or bet ter still a Sorensen apparatus

All apparatus which comes in contact with the patient should be sterilized by boiling The hand of the operator should no touch that portion of the needle which is to enter the tissue The needle is passed along the tract of the exploratory puncture already anesthetized without pain If the needle is none too sharp, it is often desirable to nick the skin with a scalpel so as to avoid an annoying degree of pressure The preliminary use of the scalpel is particularly indicated when a trocar is used When the parietal pleura is passed, aspiration may begin We are told the visceral pleura is without sensation Nevertheless patients complain when the pleura is inadvertently pricked

Permanent Drainage

In cases in which the exudate is purulent permanent drainage must be provided In children this is satisfactorily accom plished by the introduction of a fair sized (say 26 F) soft rub ber catheter through a simple intercostal incision Sometimes the catheter is pushed through the sleeve of a large trocar, after which the latter is withdrawn It is often possible to employ this method under local anesthesia in quite young children It is especially efficient also when permanent suction is to be ap plied to the drainage tube Permanent suction has been accom plished in various ways The simplest method is by the per manent application of a Potain aspirator the negative pressure in the receiving bottle being kept at the point of easy tolerance

Rib Resection

In empyema in older persons, the resection of a rib is neces sary in order to secure satisfactory drainage The diagnosis is less certain than in case of serous effusion by physical means alone Before operation it is always advisable to verify the diagnosis by puncture

The resection of a rib is a simple operation but since it is always done upon a dyspneic patient, the complications are often annoying Instruments sufficient to meet all possible emer

gencies should always be at hand Aside from the usual syringe and solution for local anesthesia, a rib shears or a bone cutting forceps, a periosteal elevator, knife, scissors and a number of hemostats and a needle threaded with catgut should be pro vided The latter may be needed should the intercostal vessels be inadvertently severed

The site of operation is selected, usually the seventh or eighth rib at the midaxillary line A line of skin 3 inches long is injected over and parallel with the rib selected for removal The

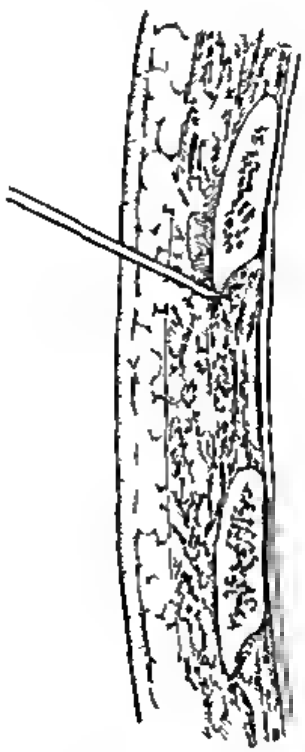

Fig 51—Injection of intercostal nerve The needle passes close under the lower border of the rib

area immediately beneath the rib at both ends of the line of injection is infiltrated in such manner as to deposit a pool of fluid about the intercostal nerve (Fig 51) The muscles must be freely injected, for they are exceedingly sensitive to incision It is stated that the periosteum need not be injected, however, if one can do this, the elevation of the periosteum is facilitated The nerve lies beneath the lower border of the rib By palpating over the surface of the rib with the point of the needle, its lower border can be accurately located A wait of a few minutes permits anesthesia to take place

Drainage of Lung Abscesses

There is no operation that demands so much of the operator as the drainage of lung abscesses The greatest difficulty lies in locating them This can be proved only by exploratory puncture Pus, macroscopic in amount, may not be encountered and cultures must be made from the serum obtained Every provision must be made for a bacterial examination Attempts should not be made to locate an intrapulmonary abscess through the unopened chest wall There is too much danger of infecting the pleural cavity We know better than to attempt the drainage of an abdominal abscess transperitoneally, but that the same objection obtains in the thorax is often forgotten

The abscess is located as nearly as possible by the physical signs One or sometimes two ribs are resected over this point according to the technic above described If the visceral and parietal layers of the pleura have already become adherent, the abscess may be searched for at once Usually this is not the case, and obliteration of the pleural space must be provided This can be best done by packing the pleural space with gauze, which will excite the pleural layers to the formation of adhesions about the gauze, after which the abscess can be drained without danger of infecting the pleural cavity

After the pleural space has been obliterated, the actual search for the abscess in the depth of the lung is now begun It is well to begin the procedure by injecting a little anesthetic into the visceral pleura The increased lung resistance is often a clue that the abscess is being approached When a cavity exists and the needle enters, the sudden lessened resistance is perceived If pus is present, it may be withdrawn Often no actual cavity is encountered but the needle may penetrate pus infiltrated tissue In that event a few drops of bloody serum may be all the operator obtains Bacteriologic examination may reveal the presence of pus microbes Often repeated punctures must be made before the abscess is located The needle must be redrawn each time until the point is just within the visceral pleura and then introduced with a change of direction Only in gross misinterpretations of the physical signs it is necessary to withdraw the needle entirely

When the pus is located, the exploring needle should be left *in situ* When the pleura has been incised the needle may be followed by a closed artery forceps in order to secure an opening large enough to admit a drain Better still is the instrument devised by me for this purpose The needle is straddled with the instrument (Fig 52) which is then forced through the lung until its tip enters the abscess The blades are then separated, the needle is withdrawn, a drainage tube substituted, and the instrument withdrawn This permits the tube to be introduced more quickly than if the dilatation is made with forceps

The opening of lung abscesses following pneumonia offers no difficulties under local anesthesia Those following prolonged suppurative processes in the pelvis or abdomen in which the patient is often pus soaked for many months and usually more

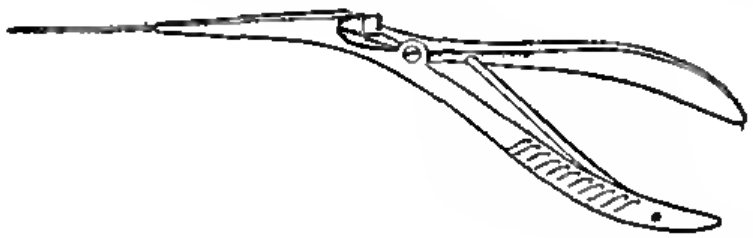

Fig 52 — Author s dilator for widening the tract to permit the introduction of the drainage tube

or less accustomed to the use of morphine are difficult cases for operation under local anesthesia Unless the operator is experienced both in the treatment of lung abscesses and in thoracic operations under local anesthesia he will do better to place the additional burden of a general anesthetic upon the patient

Thoracoplasties

When a considerable extent of one rib or several ribs is to be removed, as in rib tuberculosis or thoracoplasties, it is best to block the intercostal nerves in continuity The angle of the ribs is the place of choice The line of the proposed skin incision is first infiltrated (Fig 53) A rib is then located with the tip of the index finger and the needle pushed through the skin just above the guiding finger into the interspace The nerves lie upon the parietal pleura and the nearer the point of the

needle lies to this region when the solution is expelled, the more prompt and certain the anesthesia The trained finger can usually feel when the needle has reached the resistance offered by the pleura Usually the patient experiences some pain expressed by contraction of the spinal muscles when this region

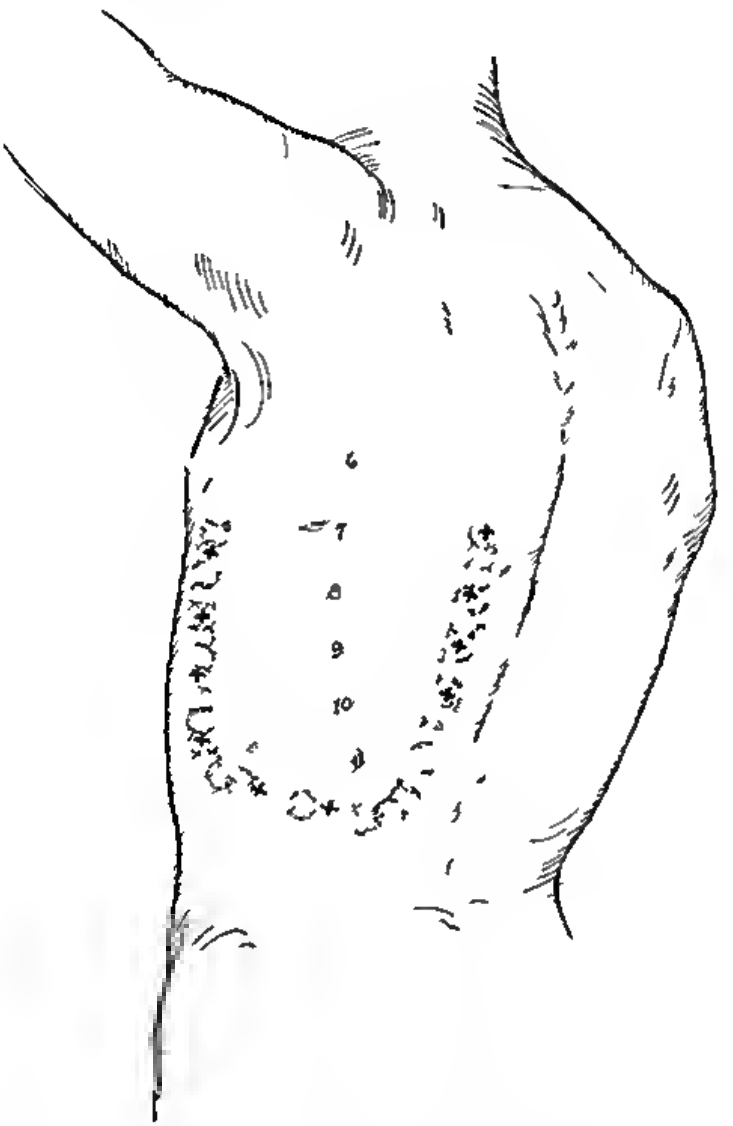

Fig 53 —The line of circles represents the skin infiltrations the marks x indicate the points at which the intercostal nerves are blocked

is reached Two c c of the anesthetic solution, preferably a 1 per cent novocaine epinephrine, is deposited at this point The number of nerves that must be blocked is dependent upon the extent of the operation In thoracoplasties, usually five or six must be blocked

Instead of the extensive thoracotomies formerly practiced, the lining of the thoracic cavities by skin flaps advised by Beck is much more desirable These also lend themselves much better to operation under local anesthesia

Usually the resection of two ribs for a distance of 4 or 5 inches according to the method already advised is sufficient A tongue shaped flap of skin three inches wide and six inches long is circumscribed by endermic infiltration This is then mobilized and turned into the cavity The flap is kept in place by grasping it at its tip with a forceps and by this means it is pushed up into the apex of the cavity The handle of the forceps is sewn into the thoracotomy wound, keeping the flap fully stretched The flap is made to lie flat by lightly packing the cavity with gauze

The thoracic wall may now be attacked in any manner desired The visceral pleura is now anesthetized, and if decortication of the lung is to be added, a general anesthetic must be administered These are formidable operations at best, and only the experienced technician is warranted in attempting them

Drainage of Subdiaphragmatic Abscesses

The technic required for drainage of subdiaphragmatic abscesses does not differ from that described for lung abscesses A rib must be resected and the pleural cavity obliterated by packing with gauze for a week as described under lung abscess if pleural adhesions have not already taken place After the necessary opening has been made in the chest wall, the abscess is located with a needle and the drainage tube introduced as in lung abscess On the whole the location and drainage of these abscesses are much more easily accomplished than is drainage of lung abscesses

Operations on the Mediastinum

The recent advance in the diseases involving the thymus and the occasional large intrathoracic goiters make operations in this region a matter of practical interest A bloodless field, which the use of epinephrine assures, is particularly desirable in order that the operators' orientation may not be disturbed when

operating in a field so full of important structures Fortunately the nerve supply to this region is such that the technic of local anesthesia is relatively easy

The mediastinum is best approached from one side rather than through the body of the sternum By removing the cartilages of as many ribs as may be necessary a wide opening is secured To approach the mediastinum by deepening the suprasternal notch is inadvisable since at best it gives inadequate room and it compels the operator to approach important structures without an adequate chance for the proper determination of their relation

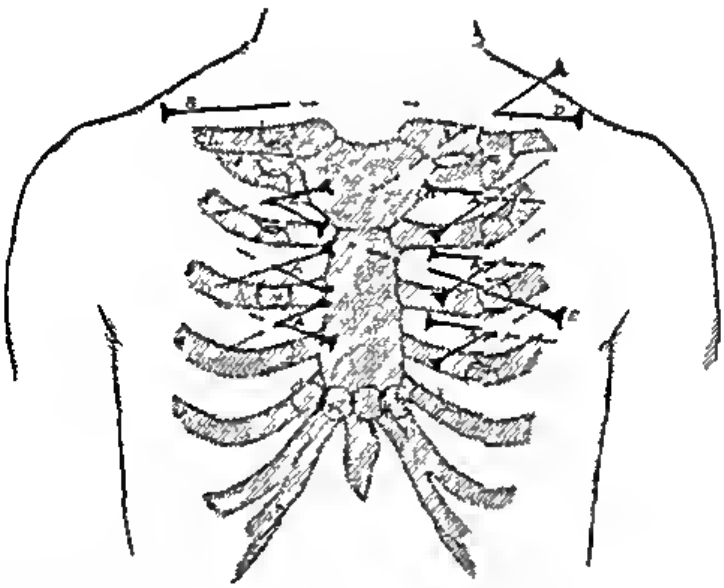

Fig 54 —Line of skin infiltration *A A* points for blocking the intercostal nerves *B D* infiltration of the suprasternal space and blocking of the cervical nerves *C* infiltration of the upper retrosternal tissues and *E* infiltration of the midretrosternal tissues

The technic I have employed is as follows the preliminary line of skin infiltration is made horseshoe shaped, with the open end upward (Fig 54) One limb of the horseshoe is placed just lateral to the sternal border on the side opposite that to be attacked The limb on the side from which the mediastinum is to be entered is placed over the line where the ribs are to be severed, which is usually at the costochondral junction

From this primary line the intercostal nerves are blocked and the periosteum of the ribs is anesthetized by injecting the solution about them It is not necessary to inject the fluid beneath

the periosteum, because if the fluid is injected about the periosteum the nerves will be blocked before they reach this structure Each intercostal space in turn is so injected (*A*, *A*, Fig 54) The operator must remember that the nerves lie just below the border of the ribs Usually the line of section of the ribs is at the costochondral junction and the skin line is made here By passing the needle through the primary line and directing it outward and backward, the nerve may be reached, as it lies beneath the rib

The periosteum of the sternum is blocked by injecting fluid over it from the primary line of infiltration This is readily accomplished if a sufficiently long needle is used The cervical nerves must receive special attention These may best be reached by making extensive subcutaneous injections from the upper end of each limb of the primary lines of the infiltration (*B*, *D*, Fig 54) This blocks all nerves coming from the cervical plexus While this is being done, it is convenient to infiltrate the loose tissues of the jugulum (*C*, Fig 54) At the upper limb of the horseshoe on each side the needle is passed cautiously behind the sternoclavicular articulation The tissues in this situation are little sensitive, but several cubic centimeters of the ½ per cent novocaine epinephrine solution should be used in order to secure complete constriction of the small vessels in this region The retrosternal tissues behind the body of the bone may be reached by passing the needle close to the bone from each of the intercostal spaces (*E*, Fig 54)

In making these deeper injections when large vessels are approached, it is well to use as fine a needle as possible and to introduce it carefully with the empty syringe attached in which the piston has been drawn back partly, so that a vacuum is created If a vessel is perforated, blood at once appears in the syringe If none appears the operator may feel safe in injecting the fluid as soon as the needle has reached the desired depth This maneuver is repeated as often as is necessary to infiltrate the entire area

The parietal pleura comes close to the border of the sternum, and the operator must bug the parietal fascia in order to reach the mediastinum without entering the pleural cavity. The operator s sense of touch must guide him in this maneuver

If the needle, such as is used for this purpose, does accidentally perforate the pleura, the puncture is not large enough to admit air If the needle perforates a vein, some oozing occurs when the needle is withdrawn, but it soon stops If an artery is perforated, a tiny geyser forms for a few seconds but this soon ceases

The incision is made down the line of infiltration, on the side from which the mediastinum is to be approached, and extended across the sternum below If the upper portion of the sternum and the jugulum is to be reached, the incision may be extended across above (Fig 54) The flap is loosened and reflected The cartilages and sternum are carefully separated from the parietal pleura The use of epinephrine lessens the oozing to a surprising extent and with care the entire series of cartilages and sternum may be so separated before the rongeur is used to remove the osseous structures The internal mammary vessels are pushed out of the way and do not require ligation

Should the pleura be inadvertently opened, the hole may be compressed with pledgets of gauze until the operator is prepared to close the opening If an abscess is to be attacked, it may be well to pack gauze into the pleural cavity and await the formation of adhesions before the operation is completed This procedure could be desirable only in the presence of suppurative processes

It has been my experience to open the pleura in several instances, but the patient experienced but little inconvenience and no distress

Operations on the Kidneys and Ureters

Many patients who require operations on the kidney are also afflicted with diseases of other organs It is such conditions that make the most conservative measures possible desirable Inhalation anesthesia makes additional hazards Spinal anesthesia has all but completely displaced local anesthesia in operations on the kidney

While local anesthesia is difficult, with care any operation on the kidneys can be satisfactorily carried out I have found local anesthesia particularly desirable in the following conditions

tuberculosis of the kidney where there is associated an active lung tuberculosis, particularly when there is a perirenal abscess and the patient is septic In such cases one hesitates to use spinal anesthesia particularly when only a simple incision is needed If the suppuration is confined to the kidney, something more is needed The kidney is split and the tuberculous foci are

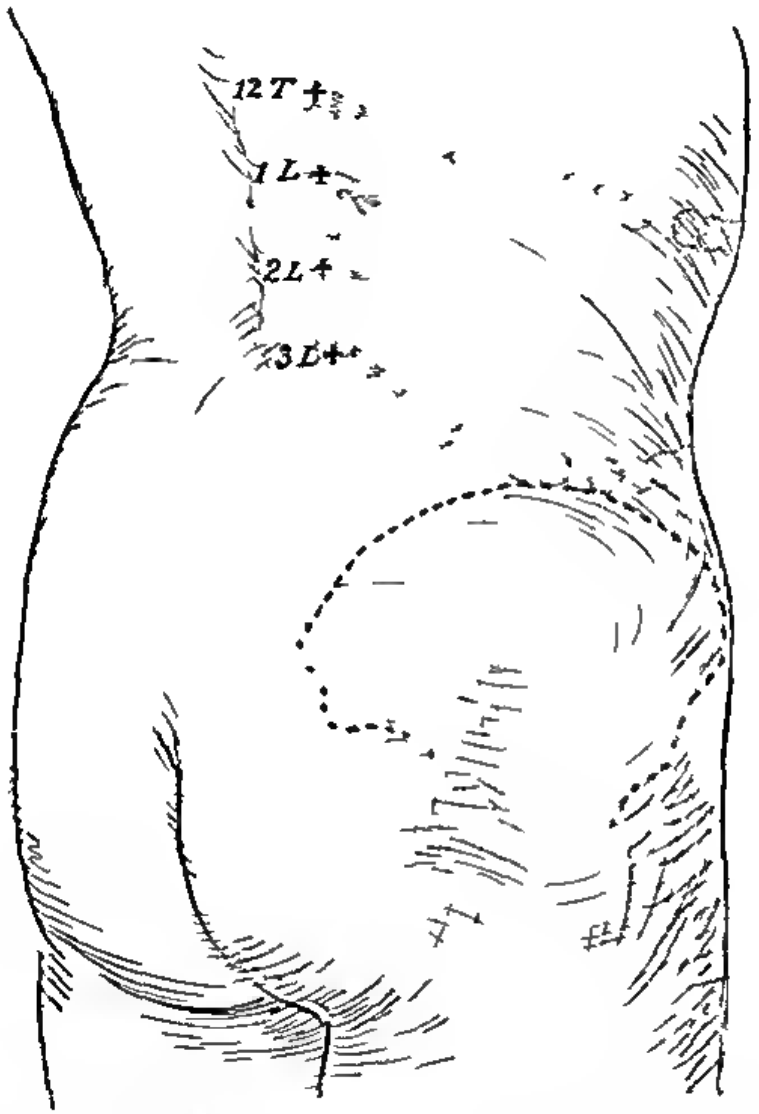

Fig 33—Line of skin infiltration preliminary to operations on the kidney and ureter, x, x, points at which the needle is introduced in blocking the nerve trunks

destroyed by an electrocautery The wound in the kidney is lightly packed with iodoform gauze and the wound in the soft parts partly closed Apparently hopeless kidneys recover and carry on a considerable degree of function after this simple procedure The opposite kidney if affected may be treated in a like manner at a subsequent sitting

Nephrolithiasis with suppuration can be isolated and the lower pole elevated and the kidney split with the cautery If the stone is not too large, a pyelotomy can be done and the stone extracted Infected kidneys clear up under this treatment When the affection is bilateral, each kidney may be treated in turn

The essential features in the operations on the kidneys and ureters under local anesthesia consist of an effective paravertebral blocking of the seventh thoracic and the first three lumbar nerves The field of operation receives aberrant twigs from nerves lying above and below this region It is well, therefore, to anticipate their presence by infiltrating the skin about the

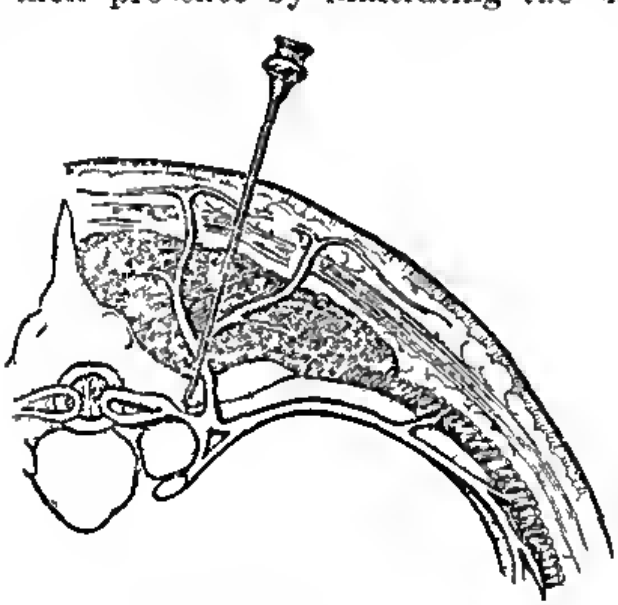

Fig 56—Paravertebral blocking The needle reaches the nerve just below the transverse process lateral to the articulation

limits of the field of operation (Fig 55) The trunks above indicated are best reached by passing the needle about midway between the spinous processes This point is reached by passing the needle forward and medially from a line 4 or 5 cm lateral to the midline opposite the upper edge of the spinous process corresponding to the nerve sought The nerves lie about on the level of the lower border of the transverse processes (compare Fig 56) and from 1 to 1½ cm deeper It is well to deposit 5 c c of a 1 per cent novocaine epinephrine solution in this region In addition, the tissues of the abdominal wall may be infiltrated by a weaker solution (½ to ¼ per cent) along the line of the

proposed incision It is well also to infiltrate the muscle layers that are to be severed If the blocking of the nerves above indicated is well done, this step should not be necessary, but the operator's marksmanship may be defective, particularly in fat patients The loose perirenal tissue may be infiltrated with a weak anesthetic solution, though this is scarcely necessary

Traction on the kidney causes some pain It is well, therefore, to have an incision in the soft parts long enough so that complete dislocation of the organ will not be necessary Incision into the kidney is not painful, but exploration of the pelvis is painful In the case of palpable stone, it is well, therefore, to make direct incision into the pelvis after infiltrating the wall

The ureter may be followed from the kidney by raising the peritoneum the required distance When the stone is palpated, it is well to infiltrate the ureter before the extraction of the stone is undertaken The chief requirement in ureteral operations is an adequate incision through the abdominal wall, in order to avoid undue tugging on the peritoneum For this reason the v Bergmann incision, downward and forward, is preferable, even when the kidney alone is to be attacked Skill in renal surgery is the prime requisite in performing this operation

CHAPTER XIII

ABDOMINAL OPERATIONS

Indications for Local Anesthesia—Operations upon the abdominal wall, including all hernias, may now be said to belong definitely to the domain of local anesthesia, operations upon the abdominal contents belong distinctively as yet to the domain of general or spinal anesthesia The chief difficulty that is encountered in the use of local anesthesia is that it is difficult to eliminate the traction pain when the intraabdominal organs are manipulated Theoretically, this difficulty can be overcome by blocking the nerves at their roots, including the sympathetic *The difficulties and uncertainties of this procedure, however,* are such that it cannot be employed satisfactorily as a routine procedure in everyday practice The traction pain on normal organs is not great, but it is heightened when the organ to be attacked is inflamed or attached by inflammation or neoplastic growths to other organs At present splanchnic anesthesia is enjoying a great awakening However, there are difficulties to be overcome, ignored by the enthusiasts, of which we do not seem to be nearing a solution The results attained in this way are not constant because sensibility varies considerably in different individuals and under different conditions For this reason enthusiastic reports published on the basis of a few cases of mesenteric blocking will usually be discounted by operators with a more extended experience

So far as present knowledge goes, success in abdominal operations under local anesthesia depends upon an exact anatomic diagnosis, a long incision in the abdominal wall, and upon gentleness of technic after the abdomen is opened Any abdominal operation can be done under local anesthesia, but the demands on the time and energies of the operator are such that at present this method is to be reserved for those patients who have some contraindication to general anesthesia, or in those in whom for some reason the surgeon discounts his own convenience wholly in the favor of the patient

Generally speaking, therefore, operations upon organs coming naturally in contact with the abdominal wall or those which may readily be brought upon contact with it may most readily be performed under local anesthesia Organs which normally lie deeper and require much traction upon their mesenteric attachments during the course of the operation are less readily operated upon

The relation of the organs to the abdominal wall may be much changed by disease The exact state cannot always be told until the abdomen is opened This difficulty may be illustrated by the citation of three cases of gall bladder trouble in old women upon whom I operated The clinical pictures of these are quite identical and the indications for local anesthesia were presented by advanced age, chronic pulmonary affections, and uncertain kidney function In the first patient when the abdomen was opened the fundus of the gall bladder presented at the incision The history together with cautious palpation indicated that the common duct was free from stones The operation was easily terminated by the removal of the stones and drainage of the gall bladder The second patient likewise had a common duct free from stones, but the gall bladder was small and deeply situated and could not be brought near the surface It was opened in situ and a tube fastened in the opening after extracting the stones In the third case, after the abdomen was opened, a mass of adhesions presented, and careful palpation and inspection failed to disclose the location of the gall bladder Ether was given at once before the patient was hurt by an attempt to locate the gall bladder by the separation of the adhesions

The difficulties of bringing the offending organ into the abdominal incision are naturally greater in the active stage of inflammation in which the sensitiveness of the organ is increased The statement of Braun that sensitiveness is not increased in inflammation is true for parts in the hyperemic stage of inflammation and for adjacent regions which are only reflexly hyperemic During the early exudative stages, however, the tissues are acutely sensitive For example, the placing or removal of abdominal sponges, which is always painful, is particularly so in the presence of acute inflammation For this reason, operations in acutely inflamed regions not adjacent to

the abdominal wall, which require a safety packing, are not ordinarily suitable for local anesthesia However, where there is a secondary attachment of the diseased part to the abdominal wall with abscess formation as in appendiceal or gall bladder suppurations, local anesthesia finds one of its most gratifying fields

In operations upon abdominal organs the operator must be an opportunist He should approach his patient prepared to use the method of anesthesia most appropriate to the condition and not predetermined to see whether the operation can be done under local anesthesia He must be able to satisfy himself as well as the patient

If an organ which is ordinarily readily accessible is found when the abdomen is opened, to be firmly bound down, general anesthesia should be resorted to at once before an attempt is made to loosen the adhesions Such an attempt would have no other effect than to hurt the patient and destroy his equanimity Similarly, if an abscess is adherent, it can easily be drained, but if the free peritoneal cavity must be traversed, requiring packing off with sponges, general anesthesia is indicated Introduction of a protective tamponade under local anesthesia should not be attempted Nitrous oxide can be easily and quickly administered and serves perfectly in most cases If a more protecting operation is required, or if a greater laxity of the abdominal muscles is demanded than can be secured by gas, the switching to ether in the hands of a skillful anesthetist is a matter of but a few minutes

Splanchnic anesthesia which consists of blocking of the sympathetic roots, adds a hopeful chapter to the local anesthesia in abdominal operations in the hands of experts By this means it is sought to inhibit afferent impulses produced by the manipulation of abdominal organs By so doing the shock producing effect of such manipulations is inhibited and should do as much toward preventing shock in abdominal operations as spinal anesthesia does in the major operations on the legs The difficulty lies in the uncertainty of the technic even in the hands of the most expert This field is the most promising in local anesthesia and much may be hoped from it in the future

Neural Anatomy of the Abdominal Wall and the Contained Organs—The abdominal walls and the viscera are supplied by different systems The cerebrospinal supply the walls, including the parietal peritoneum, while the viscera are supplied by the sympathetic system The ability of the sympathetic system to convey painful impulses has been denied by some investigators However, since no medullated fibers have been traced to the viscera and pain is experienced in them, we are left no other conclusion than that the painful impulses are conveyed by the sympathetic nerves One point in this connection not generally considered is that blood vessels are painful to pressure when all but the sympathetic nerves have been eliminated

The Nerves of the Abdominal Wall—The abdominal parietes receive branches from the seventh to the twelfth intercostal nerves and from the ilioinguinal and iliohypogastrics The thoracic nerves after leaving the spinal canal pass to the posterior surface of the intercostal membrane, which they pierce and, in company with the intercostal vessels, pass forward between the intercostal muscles (Fig 57) The ilioinguinal and iliohypogastric nerves are concerned chiefly in the operations for inguinal hernias and are described in that chapter

The intercostal nerves reach the anterior region of the abdomen by passing superficial to the transversalis muscle At their midpoint they give off branches which supply the more superficial structures, including the skin and external oblique muscle, at the lateral surface of the abdomen Other branches are given off at the border of the rectus which supply the superficial structures of the anterior surface of the abdomen.

Branches are given off near the semilunar line, which perforate the transversalis muscle or run in its substance and form a plexus superficial to the peritoneum In this manner the peritoneum receives branches from the lower six thoracic nerves and from the ilioinguinal and the iliohypogastric

Plexuses are formed by the reunion of branches of the same or neighboring nerves Branches are given off from these loops which supply the muscle itself It is from these loops too, that branches are given off to supply the peritoneum Some of these

nerves pierce the fascia at once, while others run for some distance to reach the semilunar line and perforate the fascia at or near this line to reach the peritoneum

It is important to note, relative to nerve blocking at the point of origin of these nerves, that while in general the nerves supply the region of their respective muscle segments, because of the free anastomosis and general upward direction of the terminal branches, the nerves in the segments below likewise require blocking

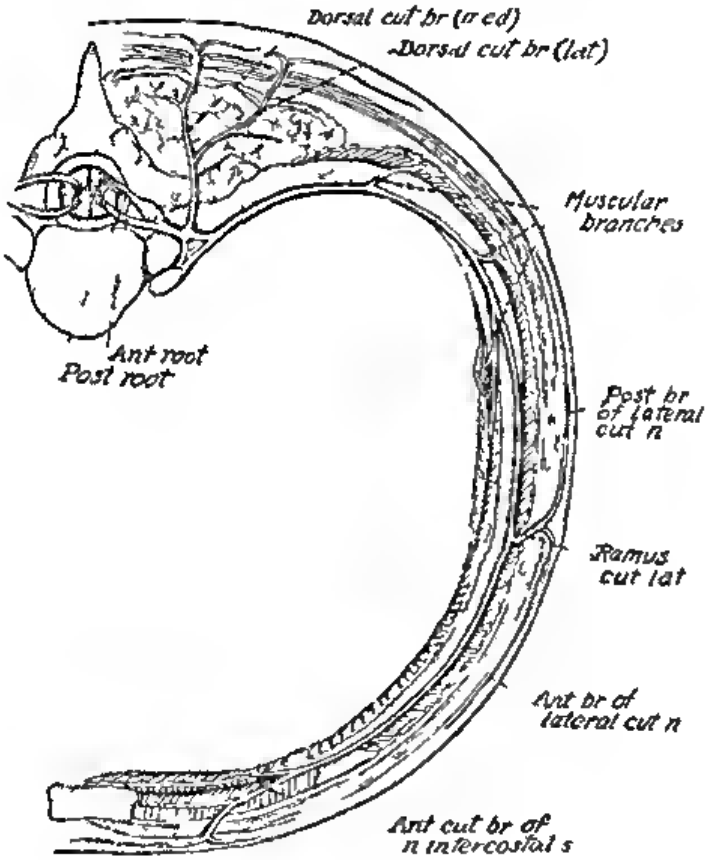

Fig 57.—Relation of the abdominal muscles and the nerves supplying the abdominal walls

It is beyond the purpose of these paragraphs to enter minutely into the study of the termination of the end organs into the peritoneum It is worth noting, however, that the terminal fibers given off from the plexuses above mentioned are for the most part nonmedullated with an intermixture of a small number of variously sized medullated fibers These latter divide at the nodes of Ranvier in such manner that in most terminal

meshes medullated fibers are found The nonmedullated fibers terminate in plexuses about the vessels, showing here and there sympathetic nerve cells singly or in groups, while the medullated nerves terminate in the subserous and serous layers in special end organs These end organs, it is sufficient to note, do not differ from the Vater Pacini bodies found in other regions of the body

Neural Anatomy of the Viscera—The neural anatomy of the viscera though much less satisfactorily worked out than that of the abdominal wall, nevertheless is capable of demonstration If one has never done so, it is well worth his time to dissect carefully the great sympathetic ganglia and the branches extending to the viscera, particularly those to the liver and pelvic organs and the communicating branches to the spinal nerves It is a tedious task, but it gives the sympathetic system a new dignity in one's mind Auerbach's plexus, situated between the muscle layers of the intestine, and a finer one, Meissner's, situated in the submucosa, are well known in theory, but one does not appreciate their size unless one has demonstrated them on a slide These form a complete web about the gut and from them filaments have been traced to the mucosa Nerves have not been demonstrated in the peritoneal or subperitoneal layer

Though sympathetic nerves going to the solid viscera are large and impressive, their ramification within the viscera, except to the hollow viscera, is little known This evidently is due to the technical difficulty of demonstrating them and not to their absence The presence of medullated fibers within the visceral plexuses is, and has always been, pure hypothecation

DeTakats, in his most excellent summary of the subject of splanchnic anesthesia seems to think that the conception of the origin and transmission of visceral pain has changed recently In 1919 I wrote as follows "The visceral peritoneum contains no medullated fibers The attitude of some writers who assume that sympathetic nerves cannot transmit painful stimuli, and agree therefore, that medullated fibers must reach the viscera, is wholly without reason Careful histologic examination has failed to demonstrate medullated fibers in the sympathetic bundles, and until positive evidence is presented of their ex

istence, it is fair to assume that they are not present Since pain in the viscera is perceived it follows, that, so far as our present knowledge goes, sympathetic fibers do transmit painful stimuli "[1]

Sensitiveness of the Abdominal Viscera—Much discussion has arisen relative to the sensitiveness of the organs involved in abdominal operations This was due to a disregard of the anatomy of the region in question and still more to an attempt to transfer data, always necessarily unreliable, derived from animal experimentation The abdominal surgeon can use only real facts The patient and not the scientist, sits as the judge of the correctness of our deductions

Broadly speaking, it may be stated that pain is caused whenever *a sensory nerve is exposed to experiences to which it is not* accustomed To this may be added that the stimuli which excite pain must be in the direction of an exaggeration of their physiologic function

The parietal peritoneum is not separable in surgical practice from the transversalis fascia, and for practical purposes it is convenient to regard the fascia and parietal peritoneum as one structure

The parietal peritoneum, therefore, like any other tissue bearing medullated nerve fibers and end organs, is sensitive to trauma of such character as excites pain in other regions supplied by similar nerve structures, the differences being dependent upon the protection of the surrounding tissue and the degree of injury

It is necessary to treat the peritoneum just as one would treat the skin if one were working from within the abdomen outward toward the skin In other words, one might turn his patient wrong side out and not alter the fundamental problems in technic

The visceral peritoneum does not contain, so far as is known any medullated nerve fibers This problem has been laboriously studied by many investigators, including myself, trained in the technic of histochemistry, and nothing resembling a medullated fiber has ever been discovered So why continue to hypothecate their presence?

[1] The Peritoneum St Louis The C V Mo by Co 1 24

The abdominal viscera are sensitive to trauma only when such trauma produces an exaggeration of their normal function or threatens the integrity of the nerve Because of the width of the meshes of the intestinal plexus, needles of considerable size may be thrust into the wall without disturbing the nerves, or at most but pushes them aside Light pinching does not cause pain, because the nerves are well padded by surrounding tissue Severe pinching which crushes the organ is painful Clamping the appendix or catching the gall bladder with forceps in order to draw it forward is painful That traction on viscera is painful is attested to by all operators This is due largely perhaps to the stretching of the nerves in the mesentery

Why crushing and stretching are painful while cutting is little or not at all painful is open to speculation Colicky pains likely are due to an undue sudden stretching of the contained nerves Cutting, if it strikes no end organs, gives no pain In opening a gall bladder, for instance if its summit is caught up by two clamps, pain is felt when each forceps is tightened No pain is felt when the top of the viscus is cut into If now the operator attempts to enlarge the opening by dilatation, severe pain is caused While the patient does not complain when the summit is cut, he objects to the use of the stone scoop inside and the nearer the duct the more the complaint

The diseased peritoneum suffers quite as many deviations from the normal in its response to stimuli as it does in anatomic structure A dropsical peritoneum (having been infiltrated by Nature) is little or not at all painful The same applies, of course, to the skin

Inflammation, as already intimated, influences the peritoneal sensibility greatly and the variation seems to follow the same general laws that govern the sensibility of the somatic system Simple hyperemia in the absence of inflammatory reaction of the proposed incision does not increase the sensibility This is true whether the vascular dilatation is caused by an irritant or reflexly.

With the beginning of inflammatory exudation, sensation is much heightened This applies to both serous and cellular exudates So far as my studies permit me to judge, that stage of inflammation, when the connective tissue is swollen but retains its

specific tinctorial reaction, is characterized by the greatest sensibility This corresponds to the height of tissue reaction against injury This stage once passed sensation lessens If regression begins, the normal is approached If the process becomes subacute, the connective tissue loses its specific reaction to dyes and approaches the fibrin reaction Tissue in this state may be relatively free from sensation If organization begins, sensation increases and may equal or exceed that of acute inflammation If a severely toxic process develops, sensation may be lessened This may be due to a soggy edema No effort on my part has revealed any changes in the nerves to account for these variations in sensibility in the various stages of inflammation

In order to give concrete form to these observations, I may hypothecate a case of appendicitis running through these various stages In the acute stage the appendix and the immediately adjacent portion of the cecum are inflamed and the pain is heightened Farther up the ascending colon is hyperemic, due to reflexes from the inflamed area, is not abnormally sensitive With the increase of the process, the walls of the appendix become swollen and adhesions are formed This stage is marked by excessive sensitiveness If this stage exists for some time, the changes in the tinctorial reaction above noted take place and sensitiveness is reduced Guts in this stage may be separated with impunity If restitution begins and permanent adhesions form, tissues become more sensitive again The pain produced by carcinomatous invasion corresponds to this stage of the reactive process

The Abdominal Incision

In order to plan intelligently the technic for the abdominal incision one must know what one is to do after he gets into the abdomen If the part to be attacked lies deep, the incision must be long If there are likely adhesions to the abdominal wall the parietal peritoneum must be anesthetized some distance on either side of the line of the incision

The Skin Infiltration—Two methods have been employed in anesthetizing the skin In one the skin is infiltrated in the line in which the incision is to be made, and the deeper parts are then anesthetized through this line In the other method, an

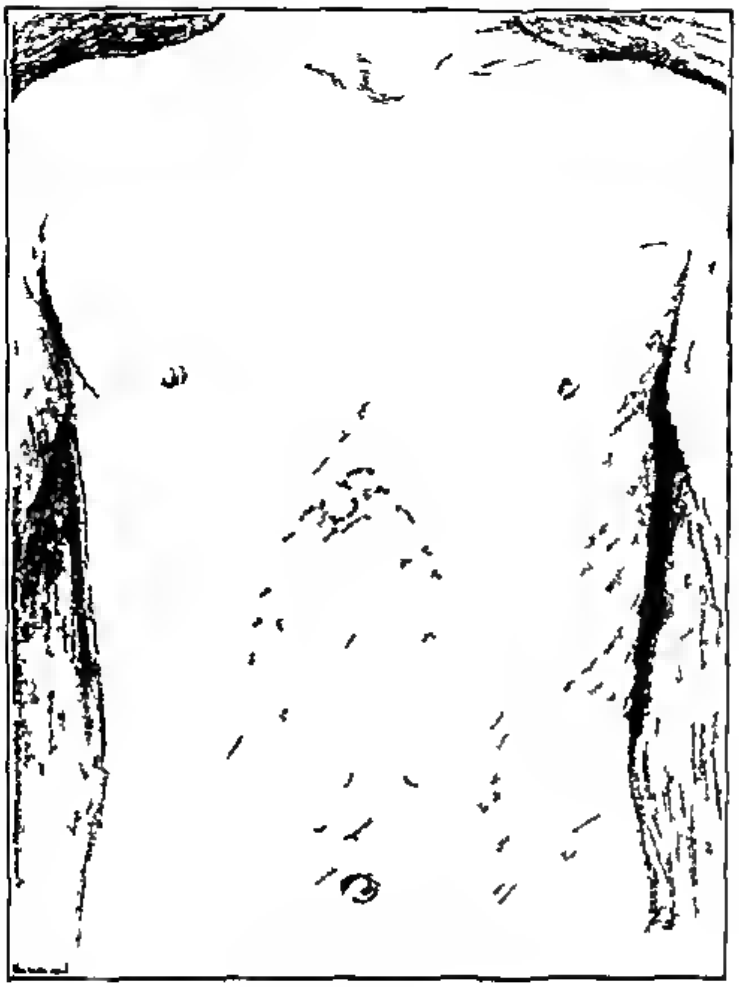

Fig 58.—Elliptical infiltration of the abdominal wall.

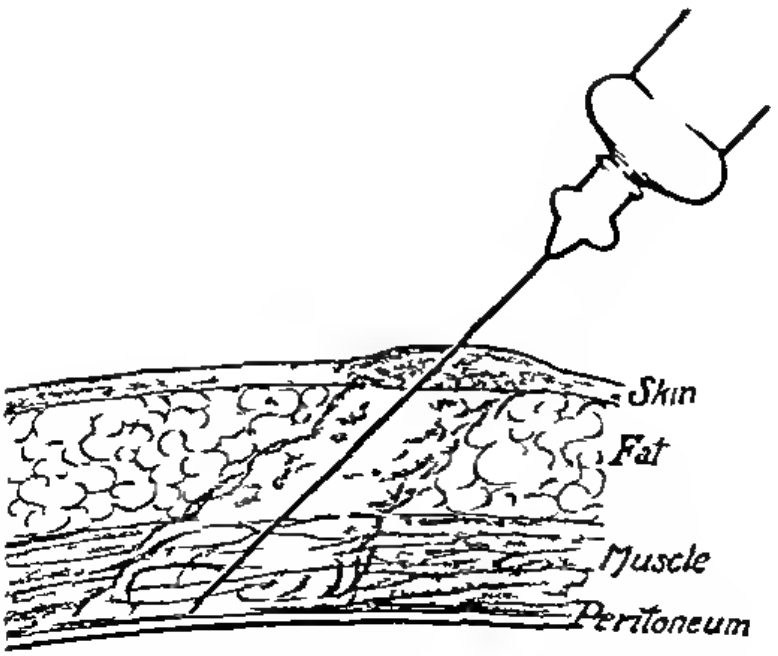

Fig 59.—Infiltration of the abdominal wall.

ellipse or a rhomboid or some other geometric figure is described about the line of proposed incision (Fig 58) The deeper parts are infiltrated first and as the last act, the subcutaneous tissue is infiltrated By this method the skin contained within the figure is anesthetized and may be incised in any part In this technic large amounts of solution are necessary My preference is emphatically in favor of the former, for the reason that a single prick in sensitive skin suffices, the subsequent injections beginning at points which are already anesthetized

Anesthetization of the Deeper Layers —The deeper parts can be reached by passing the needle directly downward through the linear infiltration (Fig 59) The subcutaneous tissue, the fascia, the muscle and the peritoneum must be successively infiltrated

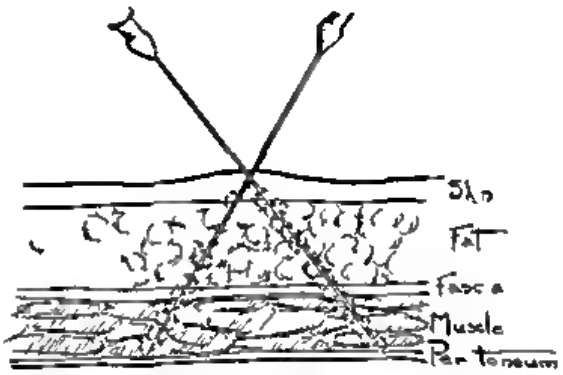

Fig 60 —Anesthetizing the peritoneum The needle is extended laterally on either side of the preliminary line of infiltration

The Subcutaneous Tissue —The subcutaneous fat contains connective tissue bundles and they may contain nerves, particularly when there are blood vessels of importance Usually, however, if the skin and the underlying fascia are well anesthetized, the fat layer will not cause trouble

The Fascia —The fascial layer is sensitive and must be anesthetized The surgeon readily feels when the needle touches the fascia If he does not, the flinching of the patient will reprove him for the lack of skill It is well to approach the fascia at a very acute angle so that the needle may glide over it After depositing solution on the surface of the fascia, the needle is then made to penetrate it and the solution is injected just beneath it This procedure must be continued until the entire line of incision has been injected

The Muscle Layers—The muscle likewise is sensitive to tearing and cutting, but not to the passage of the needle After the superficial fascia is anesthetized, the muscle layer is infiltrated It is necessary that the whole thickness of the muscle or muscles be infiltrated If relaxation of the muscle is important for the proper performance of the operation it should be infiltrated some distance on either side of the proposed line of incision

The Deep Fascia and Peritoneum—As already stated, these two structures must be considered surgically as one Since the nerve supply of these structures traverse the muscles, the nerves are blocked when the muscles are injected In order to anesthetize the fascia and peritoneum, it is only necessary to infiltrate the muscle lying upon it If adhesions are likely to be encountered, the infiltration should extend some distance on either side of the proposed line of incision (Fig 60), by so doing the desired area of peritoneum is anesthetized In the average scar hernia this should include an area two inches beyond the opening of the hernia

Exploratory Operations

Not infrequently local anesthesia finds a useful application in exploratory or confirmatory abdominal section, especially in cases in which a lesion, usually a malignant tumor, is believed to be inoperable, yet the patient demands the benefit of the doubt In such patients an exploration under ether is an operation of some magnitude, while with local anesthesia it is no more than an inconvenience Should an operable lesion be discovered, its removal may be undertaken at once under local anesthesia or a general anesthetic may be administered If, for instance, an operable pyloric tumor is present, a gastroenterostomy may be done under local anesthesia if the patient's condition demands it and the removal of the tumor may be undertaken at a later day, if the patient is in a much reduced state If not, the operation may be completed under local anesthesia at the same sitting

Local anesthesia is suitable for exploration only when the surgeon has in mind a definite condition to exclude or confirm When he has only a vague notion of some abdominal lesion,

local anesthesia will not be satisfactory, because it does not give opportunity for aimless wandering about in the abdominal cavity

The technic of an exploratory incision does not differ materially from that of any other incision If the operator expects the patient to remain in bed for a day or two only, as in operations for confirming a diagnosis, the incision will be planned in position and length so as to admit of the firmest immediate closure of the wound Thus, in case of carcinoma of the stomach a short incision high in the epigastrium will settle the question of glandular metastasis and operability through an incision that admits at most two fingers The same rule applies in cases of chronic jaundice, with suspected tumor about the gall ducts and over the sigmoid or pubes in malignancy of these regions With a short incision firmly closed the patient need not be confined to bed at all Consequently the surgeon gains the patient's consent for early operation and the patient gains the surgeon's consent for late exploration The former often and the latter occasionally, result in vast good to the patient and much satisfaction to the surgeon

The method of infiltration for exploration in any region is the same as that for typical abdominal incisions already described The method of closure and the material used should be chosen according to the site and type of incision and with respect to the condition of the patient If the condition of the patient is such that he should not be in bed long, the wound must be securely sutured When the patient is to be allowed to be up at once, the wound should be sutured with chromic gut If in addition the patient offers conditions which make a disturbed wound healing probable, as in diabetes or jaundice, figure of eight silkworm gut sutures, in addition to the catgut, furnish additional security

Operations on the Stomach—Operations on the stomach lend themselves particularly to satisfactory performance under local anesthesia because of the relatively long mesentery of the stomach and the consequent ease of access If the incision be of sufficient length the organ is easily brought into the operative field without undue tugging The single exception is large infiltrating ulcers at the pylorus

There is no pain in either the suturing or the cutting of the stomach

In much reduced patients, long the victims of a pyloric scar which causes great dehydration, the operation under local anesthesia is particularly indicated and because of the emaciation of the patient and the associated dilatation of the stomach, is correspondingly easy In such cases there is never a particle of trouble in performing the operation One must be familiar with this form of operation before he can properly evaluate the influence of splanchnic anesthesia

Local anesthesia in stomach operations finds its chief value because the patient is little prone to postoperative nausea and consequently is able to take liquids by the mouth, soon after operation

Gastrostomy—As a rule, this operation is required for carcinoma of the esophagus and is usually performed when the stomach can no longer be entered by sounds or tubes Reliable evidence as to the size and position of the stomach is difficult to secure, but it may be assumed that in such condition the stomach is much contracted An operation should, therefore, be selected which may be performed with the least possible traction upon the stomach

A line four to six inches in length is infiltrated over the middle of the left rectus muscle beginning well up at the costal margin The incision in the abdominal wall should be long enough to allow the stomach to be distinguished from the colon by inspection The technic is that already described for the abdominal incision Before the fascia is incised, the transversalis fascia should be infiltrated for an inch or more on each side of the proposed incision, so that the stomach may subsequently be attached to it without pain and to allow easy retraction of the muscle

Witzel's or Senn's operation is the preferable one when the stomach is much contracted When it is not contracted, any operation desired may be selected The stomach is not sensitive to suturing, but is very sensitive to the traction, particularly if it is adherent due to infiltration of the malignant growth or to reactive processes It should, therefore, be gently lifted to the incision by means of forceps or the fingers

Gastroenterostomy—The preliminary blocking may be made either as an ellipse or in a straight line The important thing is to have an incision of sufficient length and far enough down, in relation to the inferior border of the stomach, in order that traction upon the viscera may be reduced to a minimum Inasmuch as the operation is usually done for pyloric obstruction the lower border of the stomach must be previously determined by x ray examination

The line of infiltration in the skin should be six inches long, so that the incision in the fascia may be at least five inches long A longer incision is required than when opening under ether in order that the jejunum can be located and coapted to the stomach without too much tugging This is the most important point in the planning of the operation When the operation is done for inoperable carcinoma of the pylorus and the stomach is much bound down, the posterior operation should not be attempted because tugging on the stomach is particularly likely to be painful on account of the infiltration of the walls Since the operation is at best but palliative, ultimate results are of less importance than those in cases of benign stenosis The anterior operation is, therefore, the method of choice in these palliative operations In cases of benign stenosis the posterior operation is indicated and is likely to be easily carried out, particularly if considerable dilatation is present

In either operation whether the use of clamps is advisable or not depends upon whether or not the parts can be brought upon the surface of the abdomen If the operator is compelled to work in a measure within the abdominal wound, long clamps may exert a continuous tugging In such cases, short clamps like the Bartlett clamp may be used to advantage They can be used in any position In this clinic clamps are no longer used even when operating under general anesthesia

Feeding may begin within a few hours after operation in most cases, because there is little or no tendency to vomit This is often a matter of importance in patients who are much reduced by starvation

Gastrectomy—The removal of a part of the stomach when not bound down is easily accomplished The only difficulty will

come in severing the duodenum The section and suturing should be done in the depth of the wound without undue effort to bring it into the abdominal incision Traction on this area may excite vomiting For this operation clamps are used in the usual manner Crushing of the stomach does not produce pain

Operations on the Large Gut—Operations on the large gut under local anesthesia are usually called for to secure temporary relief in much reduced patients with obstruction of unknown origin or in patients too sick to permit radical operation Such operations may be called for in any part of the colon

Operations on the Cecum—The removal of the cecum is easily accomplished unless there are adhesions from the disease Unless this is the case the colon is easily mobilized by incising the peritoneum lateral to the colon Simple cecostomy is the simplest operation to perform and the one most often called for

The abdominal wall is infiltrated along a line 4 inches long The cecum is readily recognized by its taeniae The suturing of the gut wall to the peritoneum and fascia is not attended by pain If the condition of the patient permits, the opening into the gut may be deferred for one or more days in order that adhesions may form The incision into the gut may then be made by means of a knife or a cautery without producing pain

Colostomy—Permanent drainage of the colon in the region of the sigmoid is most often called for because of obstruction due to malignant disease The operation requires cutting across massive bundles of muscle which are more or less richly supplied with blood vessels The thorough infiltration by novocaine epinephrine gives a relatively bloodless field and permits the retraction required to secure the gut The length of the incision should be from three to five inches, depending on whether or not it is desirable to explore the abdomen in order to find out whether the lesion causing the obstruction is operable The segment to be drained is brought into the wound and held by a row of sutures surrounding the proposed opening if a permanent colostomy is to be made If the gut comes well into the wound, it can be retained in position by passing a glass

rod beneath it The mesentery in this region is long enough to permit the delivery of the gut without causing pain from traction The tumor may then be removed at a subsequent operation

Appendectomy—Either an oblique or mid rectus incision may be used (Fig 61) A lineal infiltration of the skin is made,

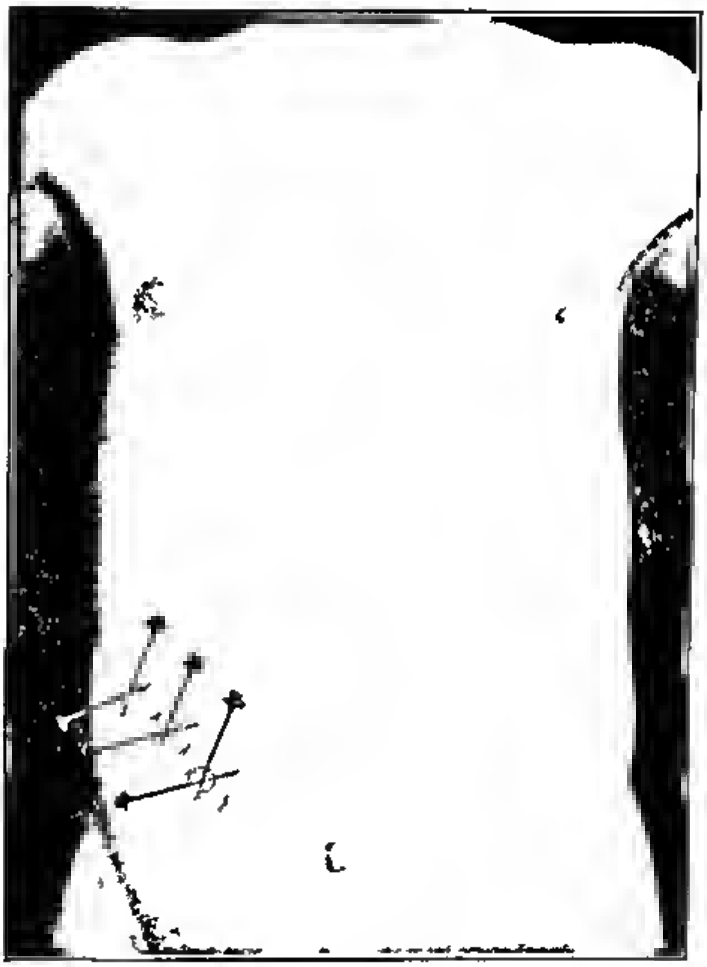

Fig 61—Linear infiltration with secondary deep infiltration lines for the incision for acute appendicitis

followed by massive infiltration into the muscle The muscle injections block nerves effectually and permit considerable manipulation of the tissue medial to them

The ease with which the appendix can be removed depends upon the location and mobility of the cecum When this can be brought into the wound easily but little difficulty will be experienced in the operation, but when the cecum is fixed by

inflammatory adhesions or when the appendix is retrocecal the operation may be by no means easy Difficulty is particularly likely to arise in the period of subacute inflammation three to six weeks after the acute attack It is this uncertainty as to the local condition which contraindicates the use of local anesthesia as a routine measure I elect local anesthesia for appendectomy only when there is some contraindication for general anesthesia

In acute suppurative lesions in which the abscess is well walled off, I have many times slid the patient to the edge of his bed, infiltrated the abdominal wall as described opened the abscess, introduced the tube and allowed the appendix to remain for a second operation This plan is particularly worth while in emergency practice in the country There are many situations, I am sure, in which patients would be better off if so managed rather than transported to more favorable surroundings All that is essential for this operation is a good syringe and a diagnosis

Gall Bladder Drainage—When a gall bladder is long enough to reach the parietal peritoneum, drainage can easily be done under local anesthesia A line in the skin and deep layers, three inches long, parallel to the costal border and an inch below it, is infiltrated and incised The gall bladder may then be grasped and pulled out into the wound and anchored either before or after a drainage tube has been placed This method is particularly desirable when the condition of the patient is unfavorable and when the gall bladder is much distended and can be palpated through the unopened abdominal wall

When the gall bladder is to be drained for stones, or when the common duct or pylorus is to be explored, a long vertical incision is preferable When the gall bladder alone is to be explored an incision parallel to the costal margin is preferable It gives better access to the gall bladder than the longitudinal incision, but is not so well suited for reaching the pylorus and does not permit an examination of the appendix

The operation does not differ from that done under general anesthesia, if the gall bladder is long enough to reach the incision If traction is necessary, the operator has the choice of

supplementing local injections by inhalation anesthesia, or draining the gall bladder deep in the abdomen and allowing the drainage tube to supply the distance between the gall bladder and the abdominal wall The chief difficulty in this plan is the proper protection of the environment while the stones are being removed

The removal of the gall bladder is not difficult if there are no adhesions and there is no inflammation If either or both of these handicaps exist, the operation is tedious and difficult

Superficial abscesses about the gall bladder may be drained after infiltration through an incision parallel to the costal border much as described for the drainage of walled off appendiceal abscesses

Generally speaking, gall bladder work is unsatisfactory because the first requisite to good gall bladder technic is proper exposure of the field of operation, and this can never be obtained as well under local anesthesia as under ether

Therefore, local anesthesia is useful chiefly by permitting drainage of the gall bladder in tiding the patient over critical periods until such time as a radical operation under ether can be safely undertaken The chief indication is in obstructive jaundice In operating on jaundiced patients particular attention must be paid to hemostasis because the anesthesia tends to close temporarily vessels which later will bleed

Perhaps sometimes splanchnic anesthesia will solve the problem, but at the present time it has added little This is due for the most part to the fact that in just those cases in which it is most needed the adhesions make it impossible to reach the sympathetic ganglia

CHAPTER XIV

PARAVERTEBRAL AND SPLANCHNIC ANESTHESIA

The recent developments in the use of spinal anesthesia have eliminated splanchnic and paravertebral anesthesia as a method of choice It is a method of election only in cases in which spinal or inhalation anesthesia is contraindicated

The difficulty of passing a needle accurately, deeply into the tissues is a considerable one In order to pass a needle 8 to 10 cm into living tissue with any degree of certainty, it must be of considerable caliber Such a needle must be of 18 or 20 caliber Thinner needles are deflected too much by the tissues to make accuracy in direction possible A needle of this size, should it penetrate a considerable vessel, is capable of doing considerable mischief A fact which seems generally to be overlooked is that it is much easier to pass a needle accurately in a cadaver than in a living body Living tissues deflect all but large sized needles while in dead tissue a fine needle can be passed with almost unerring accuracy For instance when in practice, I could hit the gasserian ganglion the first try nineteen times out of twenty in the cadaver, in the living subject it was quite another matter

In paravertebral and splanchnic anesthesia the thick muscles of the back must be penetrated Specific measurements are of little value because the thickness of the layers of the soft parts varies so much in different subjects It becomes necessary, therefore, to find some landmark in the deeper regions and when this is found, the needle is redirected from this point It is the passage of the needle from this fixed point from which the deflections of the needle are annoying for we have no definite way of knowing whether the needle has passed to the objective point or not

It must be remembered that what we seek to gain is saving the inconveniences and dangers of a general anesthetic In the graver operations, such as those for which these forms of

anesthesia are used convenience of anesthetic is not a factor that weighs heavily The dangers of a general anesthetic loom large only in exceptional cases notably in heart and lung diseases It is in such cases only that nerve blocking becomes important In the vast majority it is not the anesthetic that menaces our patient In gall bladder operations it is the dreaded embolism, the ascending cholangitis, and certain conditions, as prolonged jaundice, that make the distressing mortality The form of anesthesia makes little difference in the prognosis

Any method that makes it necessary to supplement the local anesthesia by a general, can never be a method of choice

It may be put down as an axiom in local anesthesia that if the surgeon starts with local anesthesia and must switch to ether he has injured his patient The patient would have been better off had ether been given at the start Besides the excitation caused by the failure of the local anesthetic the patient has had a preliminary hypnotic as well as the local anesthetic, both factors injurious to the patient who must take ether Unless the operator is all but infallible with local anesthesia, he had better stick to ether

Paravertebral Anesthesia

But for the difficulties just mentioned, the blocking of the spinal nerves at their point of exit at the intervertebral foramina would be an ideal procedure Another difficulty is the large number of separate injections that are required in this form of anesthesia These injections are time consuming and trying, for both the patient and the operator The amount of solution used in any nerve blocking is inversely proportional to the certainty of locating the nerve Since in this situation the approach to the nerve with the needle can never be more than approximate, the amount of fluid used must be increased in proportion Since also a considerable number of nerves must be blocked, the amount of fluid used is increased with each nerve injected

The two factors must therefore be kept in mind, the amount of fluid used and the technical difficulties of the injection The strength of the solution and the amount injected recommended

by the various operators are something as follows Lawen advises 10 c c of a 1 per cent Kappis 5 c c of a 1½ per cent, Siegel 15 to 20 c c of a ½ per cent solution The total amount of novocaine used in each case according to these operators varies between 15 and 30 grains of novocaine Since the patients receive ¼ to ½ gram of morphine or its equivalent before infiltration of the local anesthetic is begun, it can readily be seen that one must have a fairly husky patient to begin with or he could not stand such a load of drugs

When all these factors are considered it will be seen that paravertebral blocking belongs, except in very exceptional cases, to the "stunts" in local anesthesia and falls to the lot of enthusiasts and not the rank and file of operating surgeons who are interested only in the selection of the method best suited for a given case and have no interest in coddling infant ideas in local anesthesia

At the same time the theoretical problems are so enticing that continued effort toward the perfection of such a procedure should be encouraged in those who have had the proper training and favorable surroundings

When it comes to selecting these rare instances in which paravertebral anesthesia should be selected by those competent to do it, one is thrown at once into solemn thought In operations on the thorax it may be used, but it is easier to reach the intercostal nerves at the angle after the nerves have passed between the intercostal muscles In grave abdominal lesions which involve the splanchnic area, it is theoretically indicated When one attempts to designate such lesions, he may mention infections about the gall bladder, extensive involvement about the cecum or colon, pelvic lesions of various kinds and infections of the kidneys In the gall bladder infections, simple drainage after infiltration of the recti muscles, then a wait for the infection to subside seems to me the safer surgery In kidney surgery it may be employed, but it is easier to do a straight infiltration along the line of the proposed incision The same may be said in operation on the colon For pelvic operations when general anesthesia is contraindicated spinal anes

thesia is preferable to the paravertebral The indispensable place in which paravertebral anesthesia has no substitute is in operations on the thoracic esophagus

Technic—The direction generally given is to make the injection with the patient in the sitting posture Kronig and Siegel have a chair in which the patient sits while the injection is made Any patient able to assume such attitudes for the duration of time needed to make the injections must have a pretty good circulation and a belly free from inflammation If I found a patient of mine in this position I would call for general anesthesia, being assured that no contraindication to

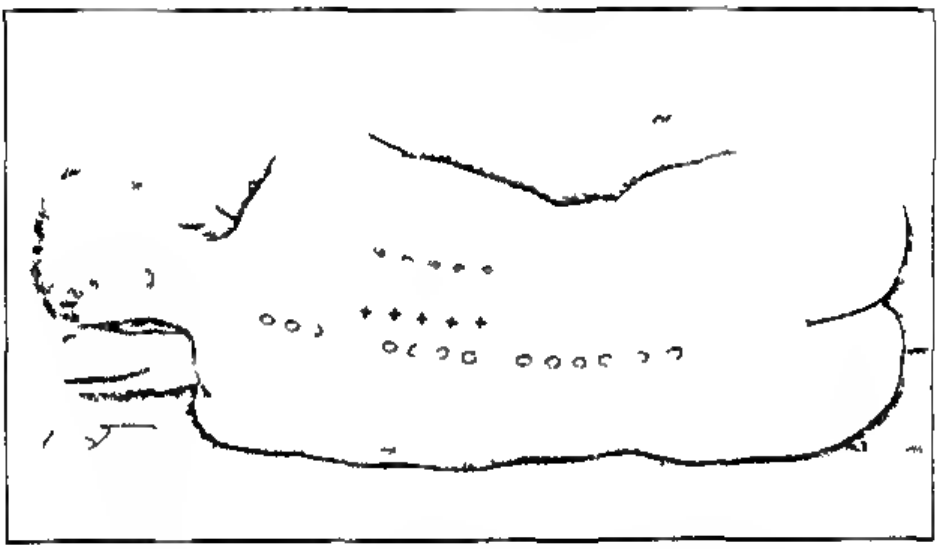

Fig 69—Showing site for injection in paravertebral anesthesia

general anesthesia exists The patients in whom I have used paravertebral anesthesia have been too sick to sit up and their bellies too sore to make it possible for them to bend forward Therefore, my description must concern the patient who can lie only on his side

The nerves to be injected must be selected The number varies between two and four In locating the desired point the twelfth rib is the most convenient guide When the spinous processes have been located a point is located 4 or 5 cm lateral to this (Fig 62) The needle is passed directly inward until the rib of the transverse process is reached The point on the needle where it emerges from the skin is marked with an artery

clamp A point a centimeter nearer the base is marked and the needle is passed to this depth while the point is directed medially From 10 to 15 cm may be injected at this point

In extensive operations on very sick patients I prefer to use quinine for the skin infiltrations, reserving the novocaine for the perineural injections By this means one can keep the amount of novocaine within safe limits

In addition to the paravertebral blocking it is well to infiltrate the abdominal wall in the usual manner By the time the abdomen has been opened the blocking infiltration has had time to act Just how much the blocking has helped, it is difficult to say I have used this method repeatedly in operations on the kidney

Splanchnic Anesthesia

The object in this technic is to deposit the anesthetic solution in the neighborhood of the semilunar ganglia This may be accomplished by passing the needle past the body of the first lumbar vertebra to reach the neighborhood of the ganglion This may be designated the posterior (Kappis) method The other is performed from in front after a laparotomy has been performed

The posterior route has the great advantage in that the injection is made before the abdominal incision is made, making it possible to allow a sufficient time to elapse for the anesthetic to take effect, before the operation is begun This method attempts to achieve in one or two injections the same results on the sympathetic system that many more injections accomplish in the paravertebral method

The anterior route is easier to perform if there are no pathologic processes to interfere with the access to the posterior parietes It has the disadvantage in that the injections are made after the abdomen has been opened and the question arises, what shall the operator do while the anesthetic is taking effect? What one naturally does is to proceed with the operation, and if he operates leisurely the anesthetic effect may begin before he has finished the operation

Posterior Route—The patient is placed on his side and the twelfth rib and the first lumbar spine are located by the tips

of a finger and thumb At a point about four fingerbreadths from the midline of the spine the needle is passed inward and toward the median line (Fig 63) The aim is to strike the side of the vertebra which is usually about 9 cm from it The needle is then partly withdrawn and the needle reintroduced and passed more lateralward, the idea being to pass along the side of the bone Labat is of the opinion that the needle should not pass more than 1 cm deeper than when the needle impinged against the side of the vertebral body This is a safe precau

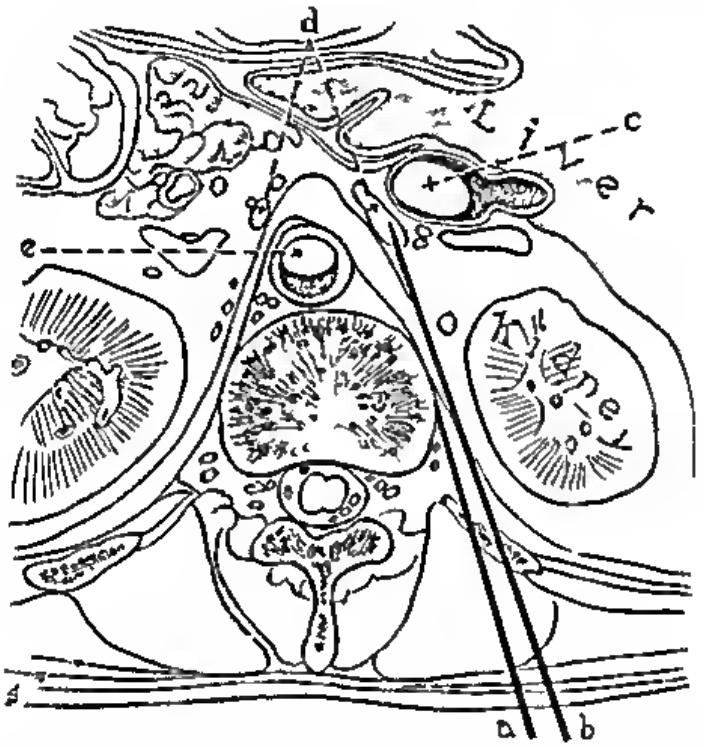

Fig 63—*a* Needle passes obliquely inward and medially striking surface of the vertebra *b* the needle is partly withdrawn and then directed more deeply to the semilunar ganglion *c* portal vein *d*, semilunar ganglia, *e*, aorta

tion but at that depth the ganglion will not be reached There is considerable peculiarly resistant fat about the ganglia which elevates them for some distance from the bone If one proceeds cautiously one may go a centimeter deeper if he proceeds with a drawn piston so that the blood will appear at once in the barrel of the syringe if a vessel is entered

It is sometimes stated that if a needle passes into a vessel and is at once withdrawn no blood will escape This is not

true Even a fine needle, if it penetrates a vessel, will be followed by the escape of blood If an artery of some size is penetrated, a fine spray, as from a fountain, will appear for a short time, even if a needle as small as 26 gauge is used This usually stops in a few moments but it may give one a

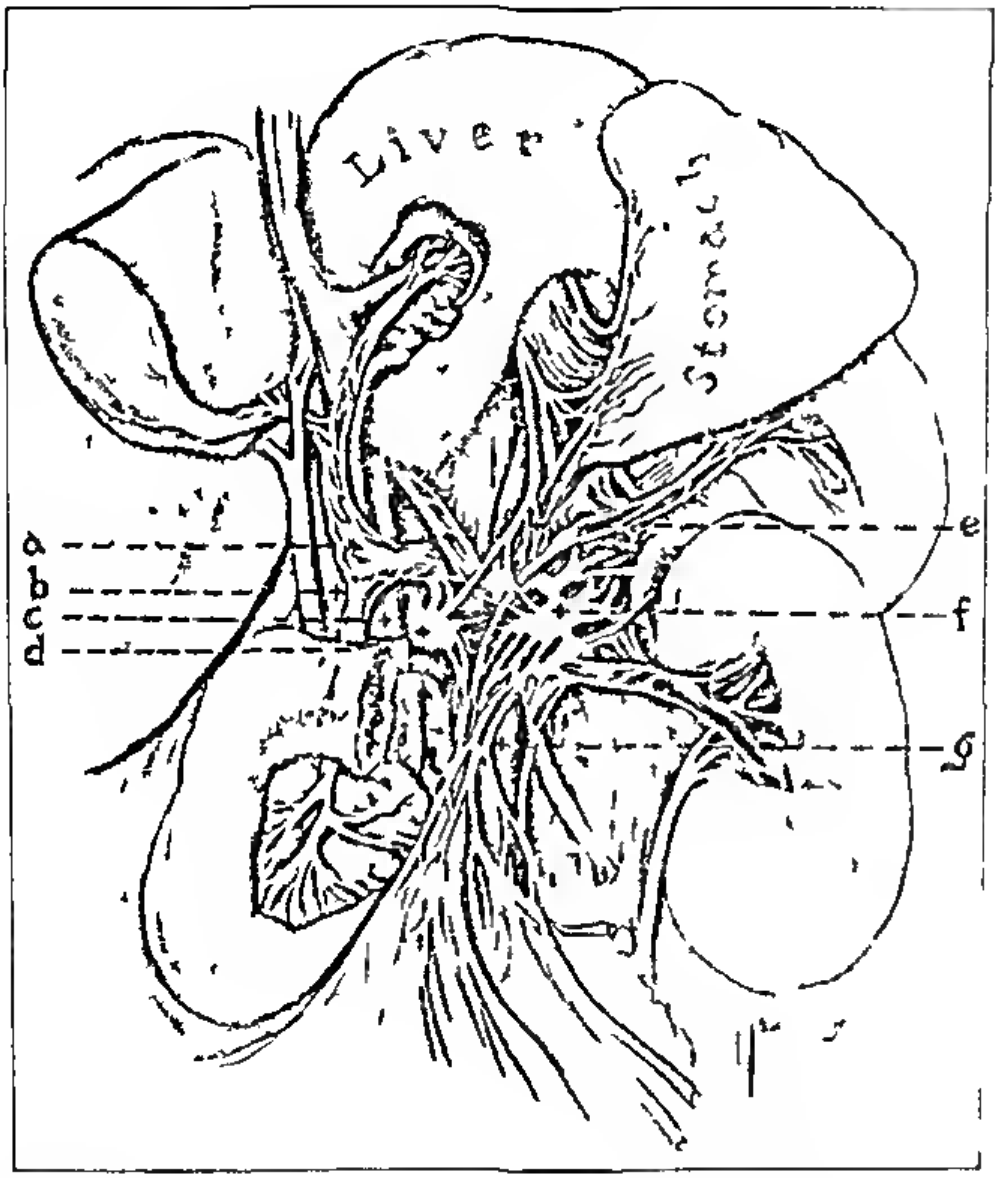

Fig 64—*a* Hepatic plexus *b* portal vein *c* inferior vena cava *d* semilunar ganglion *e* splenic and gastric plexuses *f* semilunar ganglion *g* abdominal aorta

thrill while it lasts and give him moments of apprehension when using a larger needle

When the needle passes to the desired depth the novocaine solution is injected Kappis uses 30 to 40 c c of 1 per cent solution Labat uses 25 to 35 c c of 1 per cent solution

Just the degree of diffusion in the tissue one gets with such a solution in the living subject is difficult to predict In the cadaver the diffusion is great but in the living the local expansion of tissue is greater and the fluid does not reach so wide an area

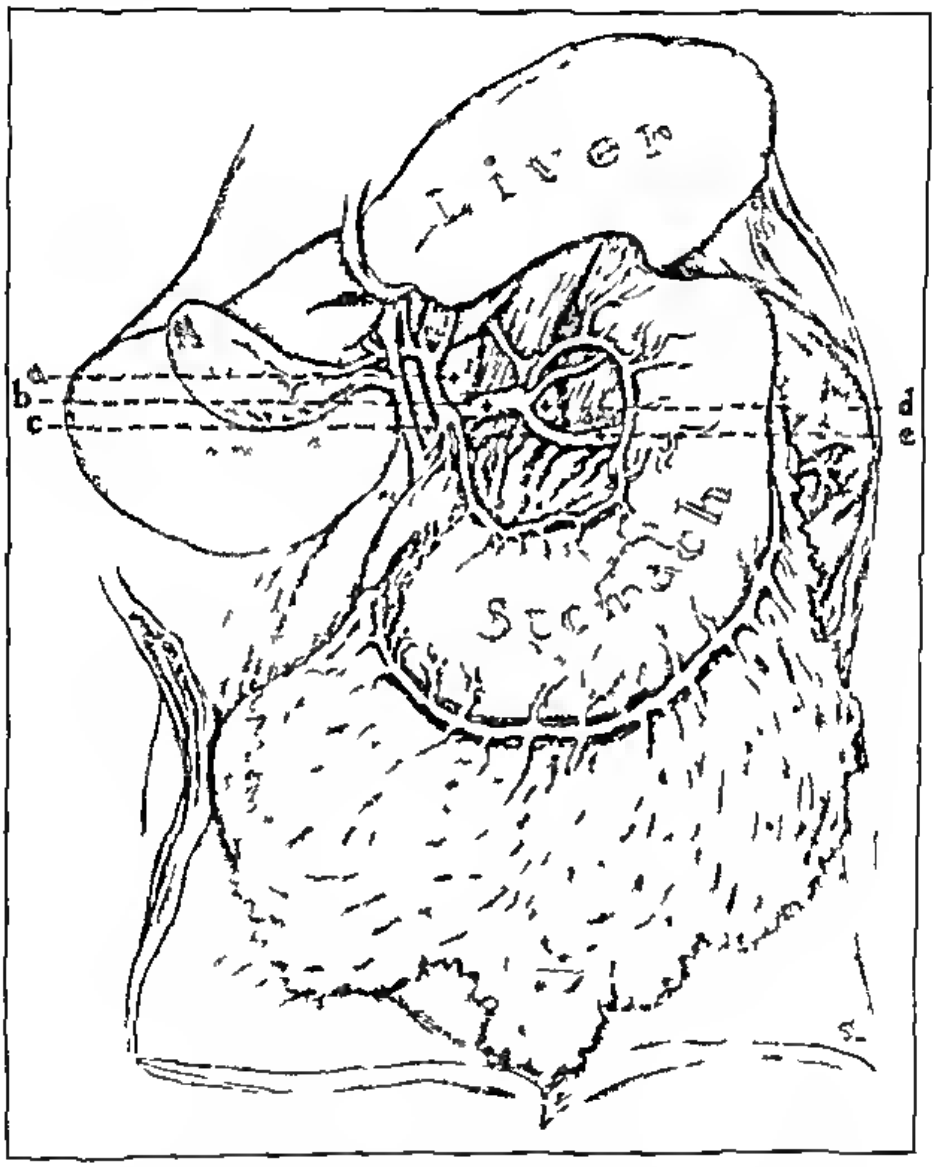

Fig 65—a, Inferior vena cava b hepatic artery c, portal vein d abdominal aorta e splenic artery

The factor that has prevented me from using this method of anesthesia with any degree of enthusiasm is the topography of the ganglia They are widely diffused (Fig 64) in no definite location or form and they are imbedded in that peculiar

liar form of fat that one finds about the coronary arteries It is characterized by the fact that no difference how much the subject may become emaciated it does not disappear It cuts with difficulty, which makes the complete dissection of the sympathetic system such a task Thus fat, I am sure, serves as an insulator against the absorption of the anesthetic fluid by the ganglia

The Anterior Route—This route demands an incision before the blocking can be begun The stomach and lesser omentum are exposed The technic is as follows (Fig 65) The index finger pushes the stomach to the left until the index finger reaches the body of the vertebra The aorta is readily palpated and is pushed to one side to permit the needle to pass The solution is injected at the lateral border of the vertebra The injection is made below the celiac axis On the right side the finger finds the space between the pancreas and the hepatic artery and the fluid injected here Braun uses 50 c c of ½ per cent solution while Panchet uses 20 to 40 c c of a 1 per cent solution Just how long it takes the solution to act, in the judgment of the various operators, does not appear Finn states that about the hepatic duct anesthesia appears instantly That is too fast I am not sure that it will ever appear The truth likely lies somewhere between these two extremes

There are two general drawbacks to this method The one has already been mentioned, namely, that having made the injection, the operator has a patient before him with the belly open and likely twenty or thirty minutes to wait before anesthesia can reasonably be expected to appear The other is more vital Before one can make the injections above mentioned, the viscera must be displaced If the organs are so movable that this can be accomplished one can proceed without difficulty without making the injections at all Patients who are seriously sick so as to make ether undesirable nearly always have pathologic changes in the neighborhood of the common duct so that the injection point cannot be reached

Let it be repeated that our mortality from gall bladder surgery is not associated with the anesthetic Therefore, I still believe, despite the popularity this method has enjoyed in re

cent years, it must still be classed as a stunt and is more suited to attract the beginner than the seasoned campaigner who has gone through all methods and knows from whence his disasters come

Stomach surgery could well be done more frequently under local anesthesia because of the lessened disturbance after anesthesia from vomiting and distention If the stomach is adherent sympathetic blocking cannot be done and if it is not adherent *one does not need it, for the operation can* be done in perfect comfort for all concerned

What is the proof that we really get a blocking of the sympathetic system? Obviously enough, the anesthesia of the part The difficulty is that it is so difficult to judge just how much anesthesia one has secured by his injection of the sympathetic ganglia Often in doing abdominal work when only the abdominal walls are anesthetized one seems to be able to do almost anything without causing the patient discomfort If one had used splanchnic blocking one would be enthusiastic about the method It is only after one has tried the same operations on the various types of patients, with simple abdominal wall anesthesia and the same plus sympathetic blocking, that one is entitled to express any judgment as to the value of the two methods The personal equation of the operator is a great factor generally overlooked One of my good friends refuses to have *anything to do with local* anesthesia in any form He thinks he is too tender hearted The fact is, he is just plain clumsy and no amount of training would make it possible to do local anesthesia Again the beginner is often prone to overlook *the fact that he is causing the patient pain If he gets by*, he thinks he has performed the operation under local anesthesia, or perhaps he has laid the patient cold by narcotics

Many of the current writings on local anesthesia bear very obviously the mark of having undergone a new experience which they are eager to proclaim to the world It reminds one of the young swain who first kisses his sweetheart in the moonlight He thinks he has discovered something new and wholly new He has and he hasn't it depends on the point of view

Actual facts are too scarce in the literature Meeker[1] has done a great service by presenting his results In 42 cases of splanchnic anesthesia a general anesthetic had to be called for in 18 cases If, in the hands of an expert under the most favorable surroundings such imperfect results are obtained, what may the average man expect?

Having operated many times, using sometimes the splanchnic blocking and more often omitting it, I cannot regard the measure with enthusiasm Theoretically the method should aid in eliminating shock just as spinal anesthesia has done away with shock following major operations on the thigh Shock, however, has ceased to be a factor in upper abdominal surgery when operating under ether Certainly in conditions with vast adhesions splanchnic blocking does not secure a sufficient anesthesia, at least not in my hands Therefore it seems to me that splanchnic anesthesia presents a hope rather than an achievement

[1] Arch Surg 10 609 1925.

CHAPTER XV

SACRAL BLOCKING AND TRANSSACRAL ANESTHESIA

To Cathelin belongs the credit for first investigating the feasibility of producing surgical anesthesia by introducing a solution extradurally He used cocaine and was enabled to induce anesthesia over the entire body of a dog by the use of 3 c c of a 1 per cent solution In the human subject he injected the solution through the hiatus sacralis into the sacral canal, but was unable to produce satisfactory results with safe quantities of the anesthetic Stockel further developed the method by using the less toxic cocaine and novocaine By the use of 30 c c of 0 5 per cent novocaine solution he was enabled to reduce the pains of parturition materially

In 1910 Lawen modified the technic of Cathelin and Stockel, and was enabled to produce constant results It had previously been shown by anatomists, and by injection experiments of Cathelin and others, that the epidural space surrounding the dura from the hiatus to the foramen magnum comprised the area between the dura and the internal periosteum and ligaments of the canal The solution, therefore, comes into contact with the nerve roots after they escape from the spinal dura after they obtain an investment from that membrane As Hartel justly remarks, sacral anesthesia is really a perineural blocking differing essentially from the intradural or spinal anesthesia Lawen, desirous of confining the action of his solution to the lower part of this canal, injected his patients while in the sitting position, or made the injection in the lateral position and then allowed them to sit upright until anesthesia was induced He increased the concentration of his solution and determined that less than 1½ to 2 per cent solutions were not effective In order to reach nerves high enough in the canal he determined that at least 20 c c of the solution was required Gros showed that the efficiency of the solution could be increased by the addition of sodium bicarbonate

Sacral Blocking

Technic—The sacral canal terminates below in the hiatus sacralis, a triangular opening the lower angles of which are marked by the sacral cornua and the apex by the termination of the *crista sacralis* This opening varies in size It may be greatly enlarged by the failure of one or more of the arches to close, and may be reduced in size by an osseous bar and even entirely closed by osseous changes in the membrane which covers it The hiatus is normally covered by the posterior sacrococcygeal ligament By passing the finger along the spines of the sacrum from above downward this membrane is usually readily palpated Lawen has aptly compared the sensation this

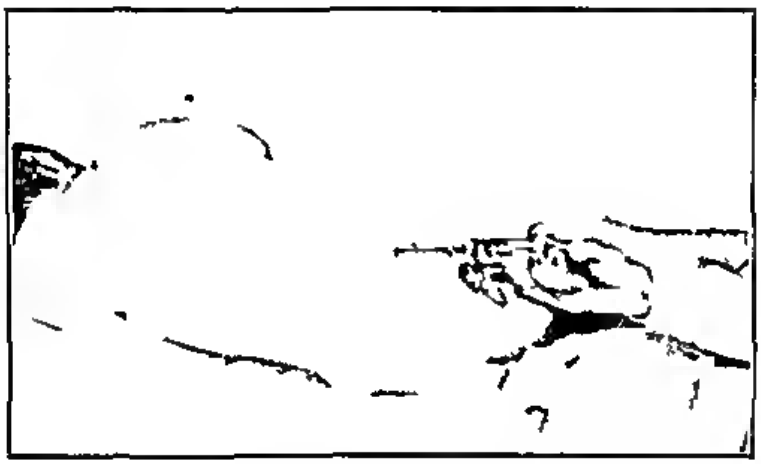

Fig 66—Position of the patient in sacral blocking (Lawen.)

membrane produces when palpated with that of a fontanelle Even in fat persons the depression can be noted with considerable distinctness When this is not possible one can find the hiatus with the needle by gently feeling the way into the canal much as one searches for the foramen ovale when injecting the gasserian ganglion By this means the canal can always be found and one need not, as Lawen does, exclude fat persons from the use of this method

It is most convenient to place the patient in the left lateral position with the knees drawn up (Fig 66) The finger of the left hand locates the hiatus A syringe, armed with a small needle, is then used to anesthetize the skin and to locate the hiatus accurately It is not difficult to recognize the foramen

The needle meets an elastic resistance quite unlike that offered by bone A little increase in pressure forces the needle through and it then passes without resistance The sensation is like that produced by passing the needle through the pleura into a pleural exudate When the foramen has been located, the small needle is withdrawn and a larger and longer one substituted If one regards the feeling of the patient less, the larger needle may be used throughout

The depth to which the needle enters must be noted The termination of the dural sac is at the 2nd or 3rd sacral vertebra, which is from 6 to 9 cm from the hiatus As soon as the needle passes the membrane, it is in the canal Inasmuch as the closure of the canal is not complete, it is desirable to deposit the fluid as near the nerve roots as possible without endangering the dural sac From the measurements above quoted a depth of 6 cm would seem to be entirely safe An ordinary needle may be used, but in order to avoid injury to the venous plexus which fills the canal, Schlimpert uses a needle constructed like a trocar After the membrane is perforated, the sharp point is withdrawn and the needle pushed upward With such a needle the danger of wounding the dural sac is obviated

Instead of using this complicated apparatus, I prefer to use a common needle which is introduced within the canal and the empty syringe attached The piston is then partly withdrawn, so that a vacuum is produced in the barrel of the syringe, and the needle slowly passed upward If the spinal canal or a blood vessel should be entered, the accident is made manifest by the appearance of their respective contents in the barrel of the syringe The danger of puncturing the dura must be very slight I have tried repeatedly to aspirate it but have never succeeded The reason is that the curve of the sacral canal is so great that the needle impinges against the posterior wall before the dura is reached Should the dura be punctured the direction of the needle must then be altered After the needle has entered to a proper depth, the syringe is filled with the anesthetic fluid and reattached to the needle and its contents slowly injected At least 20 c c of the solution must be used

When a sharp needle is used the dural sac may be avoided by directing the needle to one side or other of the median line

(Fig. 67) according to Läwen. Likewise, in order to avoid perforating the nerve roots, the outside end of the needle should be moved toward the body after the membrane is past, in order that the point may approach the posterior wall of the canal. I disregard these precautions, and, in order to injure the vessels as little as possible, begin the injection of the fluid as soon as the needle passes the membrane and continue the injection slowly as the needle is gradually passed upward. In this manner the veins are to a certain extent pushed away from the point

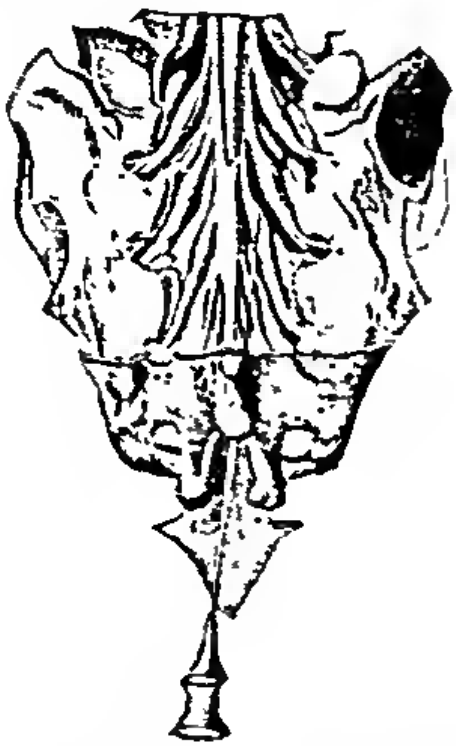

Fig. 67.—Direction of the needle in sacral blocking. (Läwen.)

of the needle by the escaping fluid. Should a vein be punctured, only a small quantity of fluid would be injected into it before the needle passes on through it. In this way 20 c.c. of the fluid are injected in the course of two minutes.

Solution Used.—According to the investigations of Gros the addition of sodium bicarbonate causes the novocaine to penetrate more readily into the nerve sheaths. Läwen on the basis of abundant experience, recommends the following:

Sodium bicarbonate	0.15
Sodium chloride	0.1
Novocaine	0.6

This is prepared in a powder and is dissolved in 30 c c of water It gives a 2 per cent novocaine solution of which 20 c c is injected

He also uses a weaker solution as follows

Sodium bicarbonate	0 2
Sodium chloride	0 2
Novocaine	*0 75*

This is dissolved in 50 c c of water to make a 1½ per cent solution, of which 20 to 25 c c is injected

The solution is prepared by dissolving the powder in the given amount of cold water and bringing it to the boiling point This brief heating assures a sterilization, according to Lawen, and increases its efficiency due, according to Gros, to the fact that the heating converts a part of the bicarbonate into carbonate which is still more hydrolytic After the solution has cooled, 5 drops of 1 1000 adrenalin solution are added Strauss adds sodium sulphate to prevent a decomposition of the adrenalin

I have used a simple 1 per cent aqueous solution with 1 gtt of adrenalin to the dram of the anesthetic fluid

Extent and Duration of Anesthesia—Anesthesia becomes complete in about twenty minutes It is first noted at the tip of the coccyx and extends over the perineum, and laterally over the gluteal region The region of the clitoris and that of the glans penis are the last to become anesthetized, then the hemorrhoidal and perineal and last the dorsalis penis The cause of the occasional partial failure to reach the latter is that they come from the pudendal plexus which sometimes derives roots from as high as the first sacral segment In addition the middle hemorrhoidal, vaginal and inferior vesical nerves are usually anesthetized The extent of the anesthesia of the latter nerves is often difficult to determine since operations upon these tissues involve more or less traction which may produce pain in regions beyond In operations upon the rectum, such as for a high fistula, or in amputations of the rectum when no traction is produced, no pain is experienced by the clamping and cutting manipulations The prostate also is insensitive to incision, but not to traction Paralysis of the motor nerves aids materially

in traction The sphincter and levator ani become lax and the parts above are reached with greater facility than when operating under general anesthesia, but even with this aid the higher operations in the pelvis may cause pain By using the Trendelenburg position Schlimpert and Schneider have secured anesthesia as high as the umbilicus In this position anesthesia seems to begin sooner, but is less certain than in the sitting position

Schlimpert and Schneider have found sacral anesthesia useful in securing relaxation during labor in old primiparas They have not found that the intensity of the labor pains is influenced by sacral anesthesia They used 50 c c of a 1 per cent solution

The duration of anesthesia is from 40 minutes to 2 hours and often longer Sensation to touch often returns before that of pain and the sensations may be confused by the patient The anesthesia usually subsides in the inverse order of its beginning, that is, the glans and the clitoris first regain their sensation and the ano coccygeal region last

Efficiency and Failures—Lawen gives detailed reports of 80 cases among which there were 7 failures His operations comprised hemorrhoids, melanosarcoma of the anus, fistulas, hypospadias and phimoses Schlimpert and Schneider reported 34 operations comprising perineal repairs, curettage of inoperable carcinomas, and rectoscopy and cystoscopy They recommended it for forceps operations and for the repair of obstetric lacerations To these Schlimpert adds 55 cases in which there were 11 failures In 12 general anesthesia had to be added because of the long duration of the operation In these cases the Trendelenburg position was used

My own experience with sacral blocking has convinced me of the value of the method in perineal operations It sometimes fails more or less, but if one is ready to supplement the sacral blocking by local infiltration, the shortcomings of the method do not work much of a hardship By using this combined method I have never had to resort to general anesthesia

Transsacral anesthesia has been largely replaced by low spinal anesthesia because it is much simpler and more certain

It is an advantageous addition where infiltration anesthesia is used in operations on or about the perineum

I have found the method uniformly useful in the cystoscopic examinations of males or for the sounding of structures For this purpose partial failures do not work as a great inconvenience and since the patient is in comparative comfort, there is no disposition to hurry the examination Retention of urine has not followed its use in my experience

The usual cause of failure, aside from such gross errors as injecting the fluid outside the canal or into a vessel, results from the use of a too small amount of fluid Two ounces of a 1 per cent solution give more certain results than half this amount of twice the strength In passing the needle *higher up*, under the precautions previously mentioned and with the use of a large amount of the weaker solutions, few failures will result

Untoward complications are few and unimportant The needle may be broken off by the sudden movement of the patient *This is unlikely to occur unless old rusty needles are* used Sometimes the patient shows a degree of restlessness, probably due to the epinephrine, but this soon passes off The large nerve trunks of the legs may be anaesthetized This may result in complete sensory anesthesia and may affect the motor fibers to the extent that the patient is unable to walk for several hours This may frighten the patient, but he may be assured that the effect will disappear in a few hours This involvement of the leg nerves occurs only when the injections are made high and a large amount of fluid is used

High Sacral Anesthesia

Several gynecologists, notably Schlimpert, have proposed to extend the usefulness of sacral anesthesia This has been achieved by making the injections in the knee chest or the Trendelenburg position and by increasing markedly the amount of the anesthetic fluid used—usually 60 c c of a 1½ per cent novocaine The first 20 c c are injected in the usual position and the remaining are injected more slowly after the pelvis has been elevated After ten to twenty minutes anesthesia will *have extended to the eighth dorsal segment*, that is, anesthesia usually appears Lawen found that this took place in 91 2 per

cent and Kehrer got it in only 80 per cent I have tried this method but have found it unsatisfactory To wait twenty minutes for a certainty is bad enough, but waiting for an 80 per cent chance is much worse When failure results neither patient nor surgeon is in the best condition to proceed to general anesthetic The undesirable complications, too, seem to be quite as frequent as in spinal anesthesia and my preference is to go at once to spinal puncture if this type of anesthesia is warranted

Presacral Anesthesia

By the term presacral anesthesia is meant the blocking of the nerves as they emerge from the anterior sacral foramina A point lateral to the areas on the level of the sacrococcygeal articulation is selected and after a dermal wheal has been made by a fine needle, a 20 gauge needle is passed along the sacrum parallel to the median line to the height of the second sacral foramen Twenty c c of a 1 per cent solution are injected here The needle is then withdrawn and is directed more anteriorly until the next foramen is reached Each foramen is then injected in turn on both sides of the rectum Most operators make the injection by the aid of the guiding finger in the rectum

The method is unsatisfactory because it is troublesome and uncertain It depends on the accurate blocking of eight separate nerves which demands a marksmanship that cannot be achieved with certainty The amount of solution used is great, from 180 to 200 c c of a 1 per cent solution, an amount which, to say the least, approaches the limit of safety

More satisfactory than this method is the infiltration about the organ to be attacked I have done many rectal amputations by simple infiltration about the rectum either with or without a preceding sacral block This method is more satisfactory in my hands than the attempt to strike the sacral nerves at their points of exit

Transsacral Anesthesia

Transsacral anesthesia seeks to block the sacral nerves at their points of exit at the sacral foramina This method is a valuable adjunct to the sacral anesthesia Just how much it adds is difficult to say Sometimes it seems to add much, some

times but little If all the anesthetic solution which is used in the blocking at the foramen were used in the sacral canal, I believe the results would be equally good because far too little fluid is used in sacral anesthesia

Transsacral anestbesia is useful chiefly in operations on the prostate and rectum It is not efficient in operations on the uterus For this, paravertebral anesthesia to the fourth and

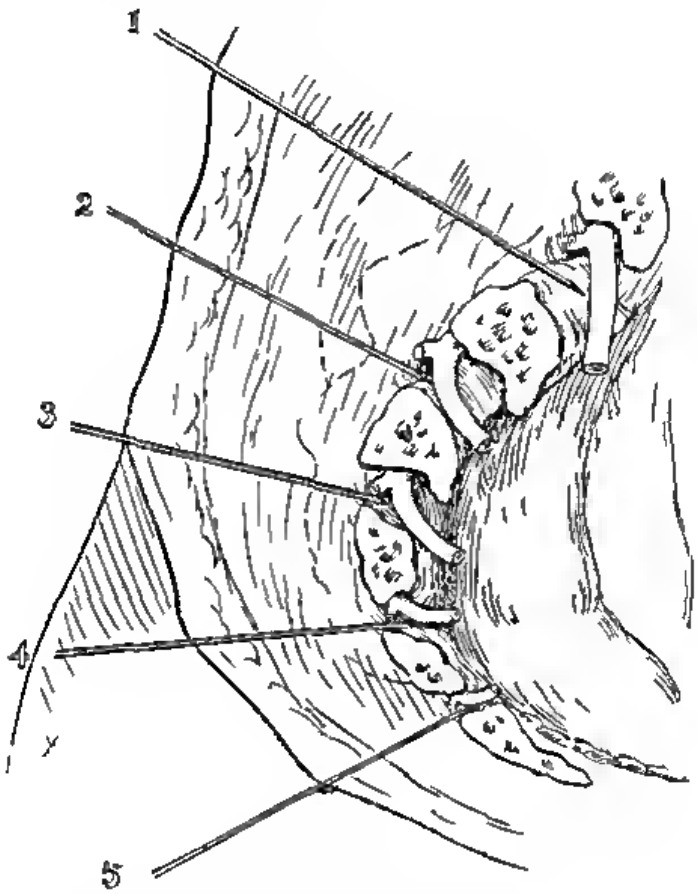

Fig 68 —The needle approaches the nerves at their points of exit

fifth lumbar would need to be added and this complicates matters too much If general anesthesia is contraindicated when such operations are needed, one had better employ spinal anesthesia

In sacral anesthesia all the five branches are usually infiltrated However, if the object is to block the bladder region, there is no use to block the first branch This is quite fortunate because the first branch is most difficult to approach

The method used in this clinic followed in general the method described by Meeker and Frazier[1] and Labat It is briefly as follows The posterior superior spines are taken as the point of departure A wheal is made 1 5 to 2 cm inward (medially) and 1 cm downward (Cand id *1*, Fig 68) This point should lie above the second sacral foramen A second point just below and lateral to the sacral coinn is located

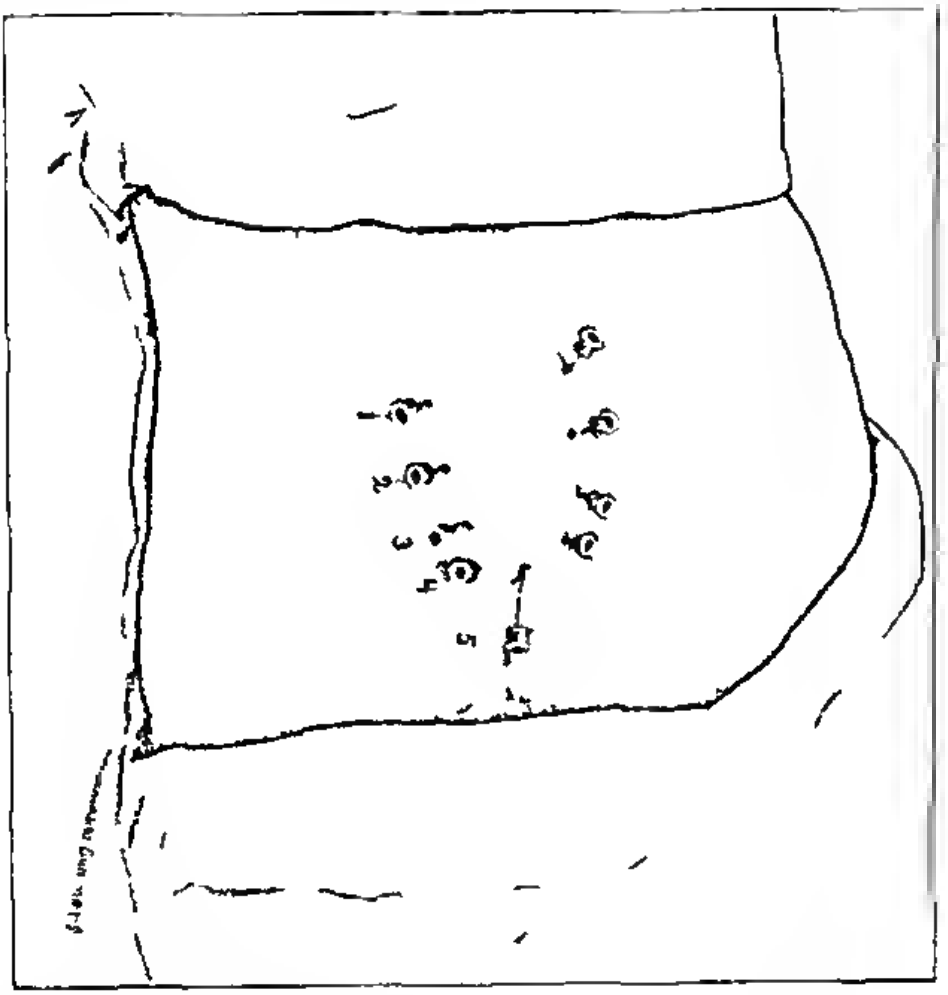

Fig 69 The *points 1 * 3 and 4 show the direction in which the needles are* passed in order to strike the nerves *5* shows a needle in the sacral canal Com pare Fig 6

This lies just above the fifth foramen (*4*, Fig 68) The distance between these points is divided equally by two additional points, which locate the second and third foramina (*3* and *4* Fig 68) Since the overlying soft parts vary in thickness, the depth to which the needle must be thrust varies at each

[1]Surg Gynec and Obst 3- 161 19[illegible]
[2]Regional Anesthesia 192[illegible] W B Saunders Co

foramen For this reason the edge of the foramen is palpated with the needle in order to use this as a guide for the passage of the needle into the foramen From this point the needle is passed 2 5 cm for the second, a centimeter less for the third, and 0 7 cm for the fourth and 0 5 cm for the fifth (Fig 69) In order to measure this depth, a cork disc may he used or a clamp may be applied to the needle the distance from the skin that the needle is to enter the canal From 2 to 5 c c of a 1 per cent solution should be injected in each foramen using the larger amount for the higher and larger nerves

This method is successful in expert hands, but is, to say the least, tedious and time consuming The method cannot be recommended for minor operations such as hemorrhoidectomies, operations on the lower rectum, perineum, and vagina There is little reason for the employment of such difficult and time consuming procedures, since all of these operations can be done certainly and satisfactorily by local infiltration

For major operations in the pelvis spinal anesthesia is to be preferred in most cases because it is simpler, more certain and requires much less labor on the part of the operator

CHAPTER XVI

SPINAL ANESTHESIA

ARCH E SPELMAN, M D
REVISED BY IRENE A KOENEKE, M D

As a result of the use of ephedrine for supporting the blood pressure, spinal anesthesia has lost to a considerable degree one of its major complications, and its use has become more general for surgery below the diaphragm It has the advantages of producing complete relaxation making it possible to do abdominal surgery more quickly and with less trauma, of minimizing surgical shock, and of reducing postoperative complications such as pneumonia and acute dilatation of the stomach The state of unconsciousness, which many patients fear more than operation, is obviated Foods and fluids may be given up to the time of operation and immediately afterward, if desirable, provided the nature of the operation does not contraindicate it

It is, however not an anesthesia to be used promiscuously or without a thorough understanding of the principles involved After the anesthetic is injected it is beyond recall

Anatomic Considerations

In order to appreciate spinal anesthesia and its complications, it is necessary to keep in mind the relationship between the spinal the sympathetic and the parasympathetic nerves

It acts upon the spinal nerve roots of the cord within the dura where they are devoid of their dense connective tissue sheaths, thus sensations of pain entering by way of the posterior roots are then stopped, and muscular relaxation is produced by paralysis of the anterior root fibers Motor nerves are more resistant to anesthesia than are sensory, hence the motor function is the last to be abolished and the first to be restored

novocaine hydrochloride crystals dissolved in spinal fluid the most satisfactory Procaine and neocaine have identical chemical formulas In order to standardize the manner of injection, the proportion used is always 100 mg of novocaine to each 1 c c of spinal fluid Novocaine crystals for this use may be procured in ampules of 50 mg, 100 mg, 200 mg, or 300 mg from any reliable drug company

Regulation of the height of anesthesia may be accomplished by varying (1) the level of the lumbar interspace at which the solution is injected; (2) the amount of novocaine used (dissolved in spinal fluid in the proportion 100 mg novocaine crystals to 1 c c spinal fluid), (3) the rate and force with which the injection is made; and (4) the spinal fluid pressure and position of the patient during and after the injection A fifth factor on which the height of anesthesia depends is the nutrition of the patient The more obese the patient, the more quickly is anesthesia produced and with less anesthetizing solution The extremely thin, tall individual requires a greater degree of the factors mentioned above

Level of Injection

The conus medullaris in the adult never reaches below the first lumbar vertebra, and spinal puncture at or below this level can be accomplished without danger of damaging the spinal cord This is the upper limit of the site of injection The terminal portion of the dural canal always reaches to the fourth lumbar interspace, but in about 30 per cent of adult individuals it fails to reach the fifth lumbar interspace Thus in adults we may inject anesthesia in the first, second, third or fourth lumbar interspace and the higher the injection the higher the anesthesia produced The second or third space will take care of any operation below the diaphragm

Novocaine Dosage

Two hundred mg ampules only are used in this hospital and dosages are determined from this If 200 mg of novocaine dissolved in 2 c c of spinal fluid is injected at the first lumbar

interspace at the rate of five seconds per cubic centimeter, anesthesia, in the large thin individual, will often reach to the first and second intercostal space This is sufficiently high to do any abdominal surgery including the stomach and the gall bladder In the average sized adult 180 mg in 1 8 c c of spinal fluid is sufficient

If a prolonged upper abdominal anesthetic is anticipated, 200 mg novocaine dissolved in 2 c c spinal fluid can be given if the rate of injection is regulated and the patient is maintained in a level position until the height of anesthesia has been established This usually takes fifteen minutes and can be done provided the blood pressure does not start downward In such a case the head of the table is immediately lowered fifteen degrees One hundred mg of novocaine injected in 1 c c of spinal fluid at the fourth lumbar interspace in the average individual will produce anesthesia sufficient to do perineal, anal, or vaginal surgery, but may not cause anesthesia of the legs Between these two extremes we must gauge the anesthesia to meet requirements

Low abdominal surgery, including work in the pelvis, on the bladder, appendix or the sigmoid, and rectal amputation may be accomplished by injecting 150 mg of novocaine mixed in 1½ c c spinal fluid in the second interspace This is also sufficient for work on the lower extremities Such an anesthesia will last from one to one and one half hours

If operations are performed quickly and with a minimum of handling the viscera, these doses of novocaine may be reduced even lower In our clinic 150 mg of novocaine is used more often for low abdominal surgery and 180 to 200 mg for work in the upper abdomen This must, however, be varied to meet the requirements of both surgeon and individual patient Fifty mg novocaine is sufficient for cystoscopic examinations This low dosage is used so that the kidney pelvis will not be anesthetized It is then possible for the patient to differentiate the pain he has had when the kidney pelvis is injected

Force or Rate of Injection

Height of anesthesia may be varied greatly by the force with which the anesthetizing solution is injected Sharp pres

sure on the syringe plunger may force the solution in rapidly enough to cause it to mix with spinal fluid much higher in the canal than is desired It is best to standardize the rate of injection to 1 c c every five seconds and to vary this only as the individual case demands

Spinal Fluid Pressure

Dehydrated patients, e g, those with pyloric obstruction who have been vomiting for a week or more, have a low spinal fluid pressure, and anesthesia does not extend as high as in cases in which pressure and diffusion are normal This pressure remains low regardless of subcutaneous and intravenous fluids given preoperatively

Variation in Individuals

It would seem reasonable to consider, as described by many writers, that the larger an individual the more anesthesia required to produce a given result The fact, however, is contrary, and it is only by learning to estimate the individual susceptibility to intradural novocaine anesthesia that the most satisfactory anesthesias will be produced We cannot classify strictly, but at one extreme is the tall, thin individual and at the other the excessively corpulent, short patient

If we attempt to administer anesthesia to these two individuals with the same technic, the results will be greatly varied Injection made to produce an eighth rib anesthesia in the first patient may produce a fourth rib anesthesia in his corpulent companion Thus a smaller dose of anesthetizing solution and injection with less force in the fat individual must be practiced It is a safe rule to be overcautious with the elderly, obese, short chested patient, for anesthesia produced too high may be attended with symptoms of respiratory paralysis and circulatory failure

Preparation of the Patient

The day preceding the operation the patient should receive ample fluids to combat any tendency to dehydration

The evening preceding operation the colon should be thoroughly cleaned by enemas as paralysis of the pelvic nerves re

laxes the anal sphincter and feces may be discharged during the operation Three grains of amytal are given by mouth to secure adequate sleep

The morning of operation the lumbar and sacral regions should be washed with green soap, rinsed with alcohol, dried and covered with a sterile towel Three grains of amytal by mouth and one sixth to one fourth grain of morphine hypodermically are given one and one half hours before operation For the aged or cachectic these doses are halved The patient should be kept quiet after this medication is given and later removed to the operating room with as little disturbance as possible

Ephedrine

This drug has the property of stimulating the peripheral nerve endings of the vasomotor system Paralysis centrally caused by anesthesia of the nerve roots in the spinal cord may thus be counteracted in a measure by intramuscular or subcutaneous injection of this drug By the use of 75 mg of ephedrine administered intramuscularly five minutes before the injection of novocaine in the dural canal, the blood pressure may be maintained near the normal level It is our practice to use this dosage in patients whose anesthesia is to extend above the umbilicus For anesthesia below the umbilicus 50 mg of ephedrine is usually sufficient unless the systolic blood pressure approaches one hundred Hypertension patients require the full dose of ephedrine or they will have a relatively greater fall of blood pressure than a normal person

The blood pressure and efficiency of the respiratory centers are also affected by cerebral anemia, this may be largely overcome during operation by lowering the patient's head approximately 15 degrees after the anesthesia level has been reached

Material Necessary for Anesthesia

The table is set up with an ampule of 200 mg of novocaine crystals, 2 ampules of 50 mg of ephedrine solution, 1 ampule of 1 c c of 1 1,000 adrenalin solution, a small file for opening ampules, 1 novocaine tablet to be mixed in one ounce glass with one half ounce water for local anesthesia, 1 five c c syringe to

inject local anesthesia into skin and interspinous ligament, 1 three c c syringe for injecting novocaine solution intradurally, and 1 one and one half c c syringe for injecting subcutaneously the ephedrine solution Needles used should include 2 short bevel 4½ inch (20 gauge) spinal puncture needles, 1 two inch needle (22 gauge) for injecting the interspinous ligament and 2 hypodermic needles (27 gauge) for subcutaneous injection of novocaine, and one two inch needle (26 gauge) for intramuscular injection of ephedrine A routine arrangement of this equipment (Fig 70) is desirable Short bevel spinal fluid

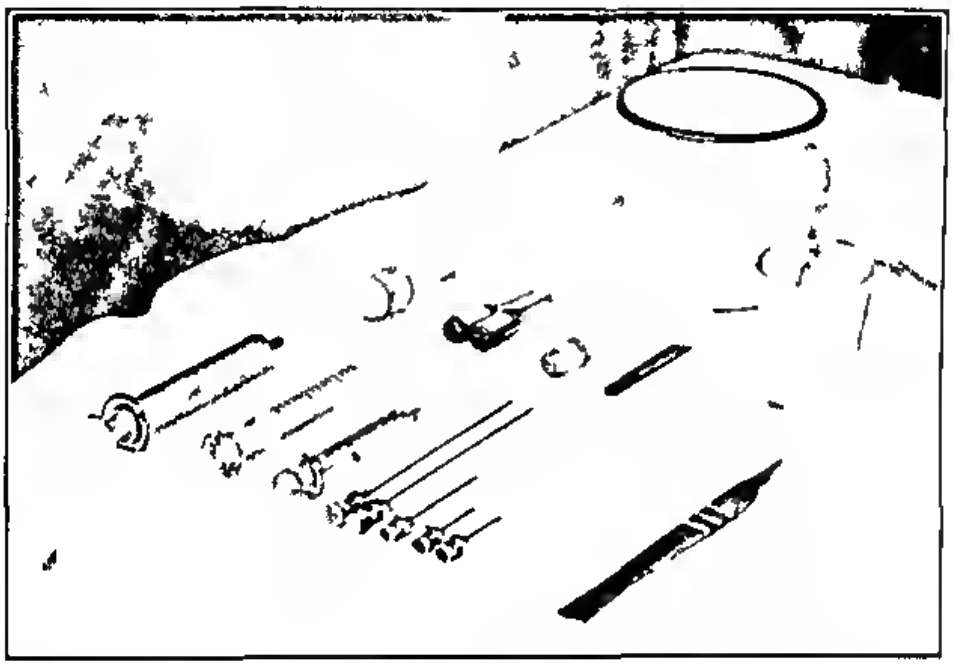

Fig 70 —Equipment necessary for administering spinal anesthesia Standardizing arrangement of this will aid the operator

needles minimize the chance of pushing only a part of the needle point through the dura Such a relationship between dura and needle would make it possible to inject a portion of spinal fluid extradurally and thus fail to establish anesthesia They also minimize the incidence of inserting the needle into the anterior wall of the dura with subsequent bloody puncture

Technic of Administering Spinal Anesthesia

Shortly before the scheduled time of operation the patient is brought to the operating room, an assistant takes the blood

pressure, placing himself so that repeated readings may be taken during the course of the operation (Fig 71)

The patient is then turned on either side as convenience requires (the description following being based on placing him on the left side) Spinal anesthesia should never be administered with the patient in the sitting position

The assistant with his left arm behind the patient's knees draws them well up on the abdomen The assistant's right hand is placed on the patient's left shoulder, the assistant's

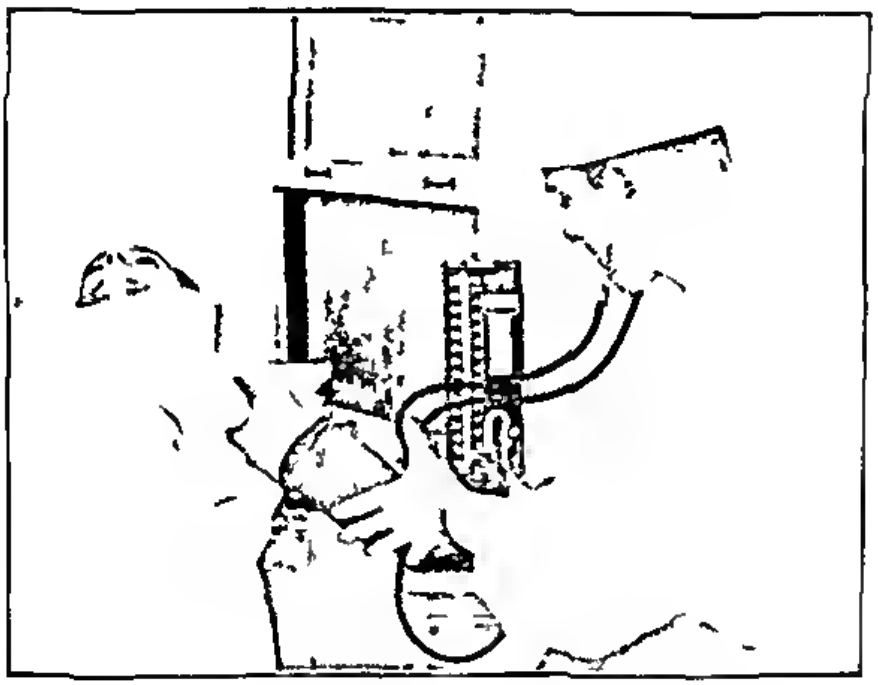

Fig 71 — A blood pressure reading should be made by the assistant when the patient is brought to the operating room

elbow on the patient's head, and with the latter the neck is flexed toward the chest The transverse axis of the hips and shoulders should be perpendicular to the table so that no twisting of the spine will occur (Fig 72) The back is brought well out to the edge of the table, painted with picric acid, and sterile towels are draped above and below the field Picric acid produces fewer skin reactions than iodine

The assistant, who has been holding the patient loosely during this procedure, then draws the knees up firmly toward the abdomen and pressing on the shoulder with his right hand

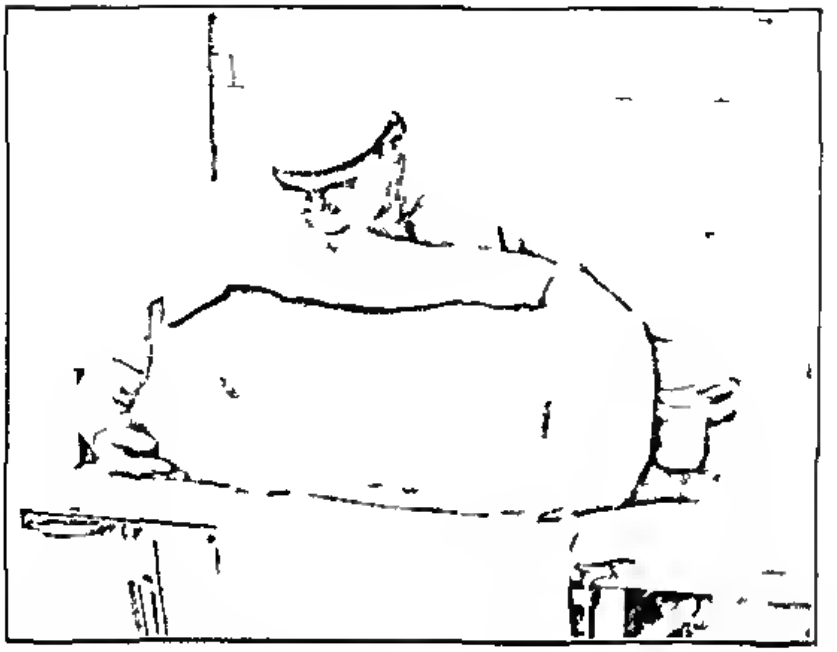

Fig. 72.—Showing the manner in which the patient is held by the assistant. The transverse axis of the shoulders and hips should be perpendicular with the table, avoiding any twist of the spine.

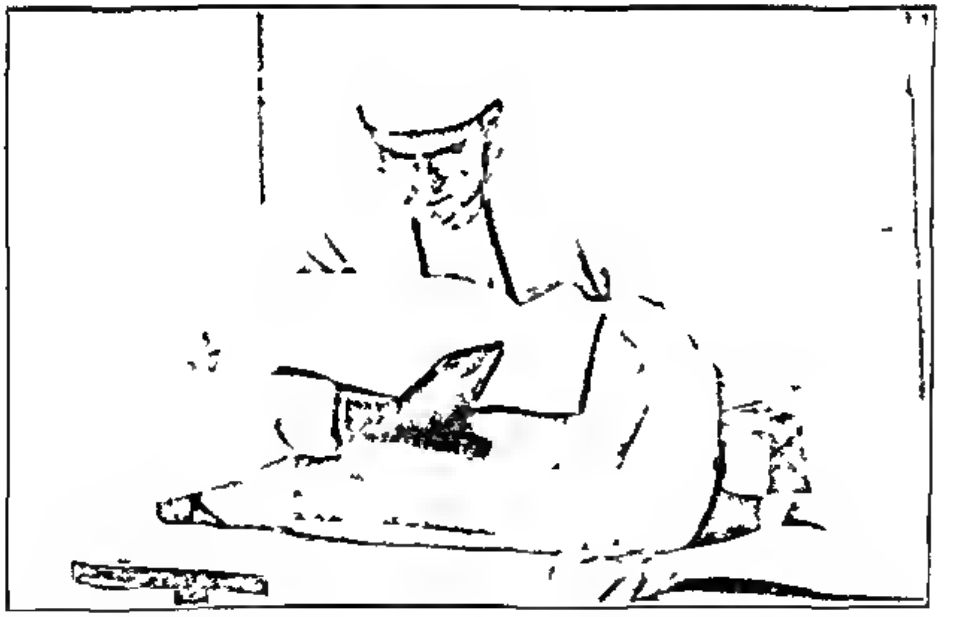

Fig. 73.—To find the third lumbar interspace the operator places his hand on the patient's hip with the index finger on the crest of the ilium. The third interspace is slightly above a line perpendicular to this. The assistant should exert only pressure enough to steady the patient during the procedure.

and on the head with his elbow flexes the neck firmly toward the chest This widens the interspinous space and pressure on the head causes a slight pressure on the jugulars, thus raising the intradural pressure and aiding the flow of fluid through the needle when the puncture is made

The hand is then placed so that the index finger is on the crest of the ilium, and the thumb finds the third lumbar interspace slightly above at, or below this level (Fig 73) From this the interspace for injection is found Here a small novocaine wheal is raised with a hypodermic needle, and the needle then changed to one of 2 inch 26 gauge and 50 or 75 mg

Fig 74—The desired interspace is found a novocaine wheal raised over this and with a two inch needle the interspinous ligament is infiltrated with novocaine

ephedrine injected deeply to the right into the paravertebral muscles The needle is then changed to one of 2 inch 22 gauge, and 1 c c novocaine solution is injected into the intraspinous ligament (Fig 74)

With the left hand guiding it, the needle is inserted close to the lower margin of the spinous process above the interspace and kept at right angles to the spinal column (Fig 75) A cartilage like resistance is felt as the needle passes through the interspinous ligament The ligamentum flavum gives a distinct resistance in most cases, and a snap is felt as the needle pierces it The dura usually offers less resistance, and a snap

is also felt as the needle punctures it There is then a marked diminution in resistance as the needle point passes into the canal

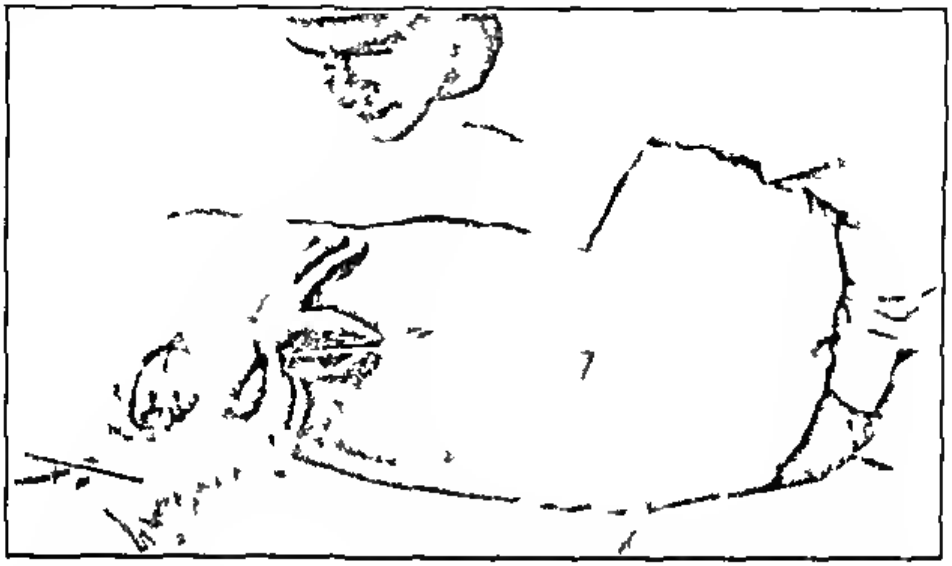

Fig 75—Through a small incision the spinal puncture needle is inserted close to the lower margin of the process above the interspace and pushed through the interspinous ligament, being kept perpendicular to the spine A snap is felt in most cases as both the ligamentum flavia and the dura mater are punctured During this process the patient is held firmly by the assistant bowing the back as much as possible

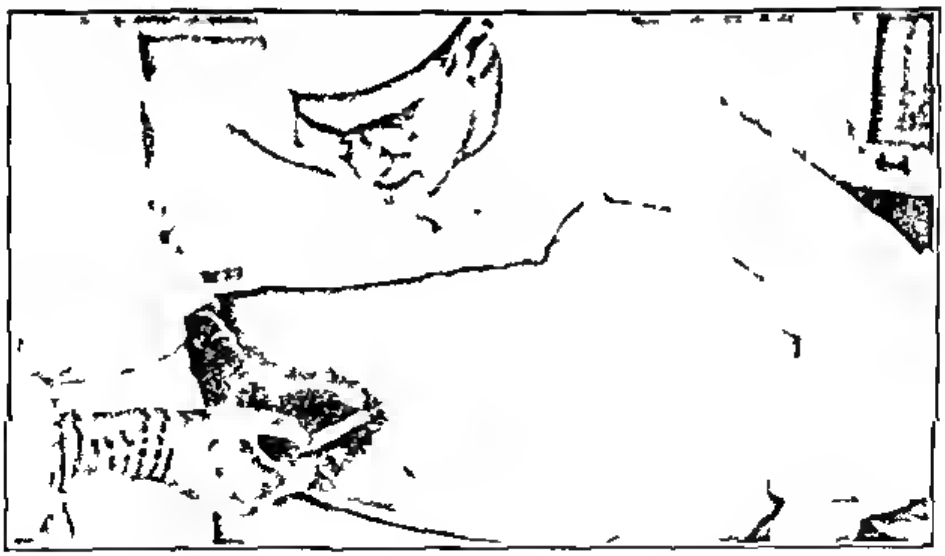

Fig 76—The 3 c c syringe is attached and with the knuckles of the left hand against the back and the first finger and thumb holding the needle there is no danger of moving the needle while fluid is gently drawn into the syringe

The stilet is then withdrawn from the needle, a few drops of spinal fluid are allowed to flow out, and the 3 c c syringe

is attached Gentle pressure should be exerted on the plunger to withdraw 2 c c of spinal fluid (Fig 76) If fluid does not flow through the needle when the stilet is withdrawn, the needle should be carefully rotated

A bloody puncture is sometimes seen and almost always means that the needle has been inserted through the anterior wall of the dura, puncturing the plexus of veins beneath If the spinal fluid clears up after running through the needle a few moments, the puncture may be used, otherwise a new puncture should be made at a different level Bloody punctures are not

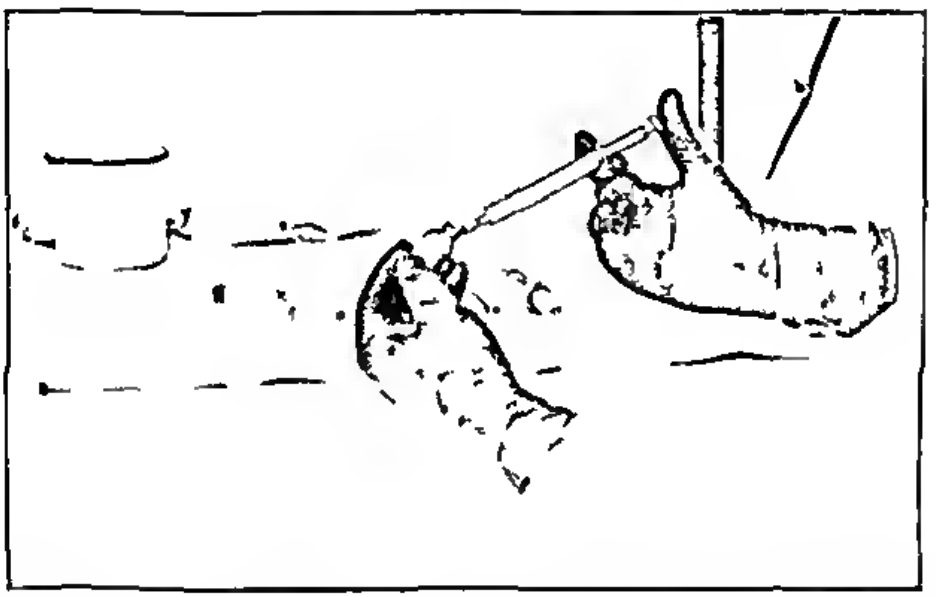

Fig 77—Spinal fluid is injected into the novocaine ampule mixed until the crystals are dissolved and again drawn into the syringe The proportion of spinal fluid should always be 1 c c to each 100 mg of novocaine From this the exact dosage required may be drawn into the syringe

obtained, however, if care is taken to make the puncture in the midline and the needle is inserted only a few millimeters past the dura

When 2 c c of spinal fluid have been drawn into the syringe, the syringe is disconnected, the needle stilet is replaced and the fluid is injected into an ampule of 200 mg of novocaine and mixed until the novocaine is dissolved (Fig 77) Each cubic centimeter of solution contains 100 mg of novocaine, and, if the entire ampule is not to be used, the dose may be easily gauged

by the syringe markings Thus if 200 mg of novocaine is dissolved in 2 c c of spinal fluid and only 150 mg is to be used, 0 5 c c is discarded and 1 5 c c of solution is maintained in the syringe, which contains the proper dose of novocaine

The syringe is then reattached to the spinal puncture needle and the plunger gently withdrawn until spinal fluid is seen to enter the syringe to make sure that the needle point still lies in the dural canal, then the solution is injected at the rate of 1 c c every five seconds

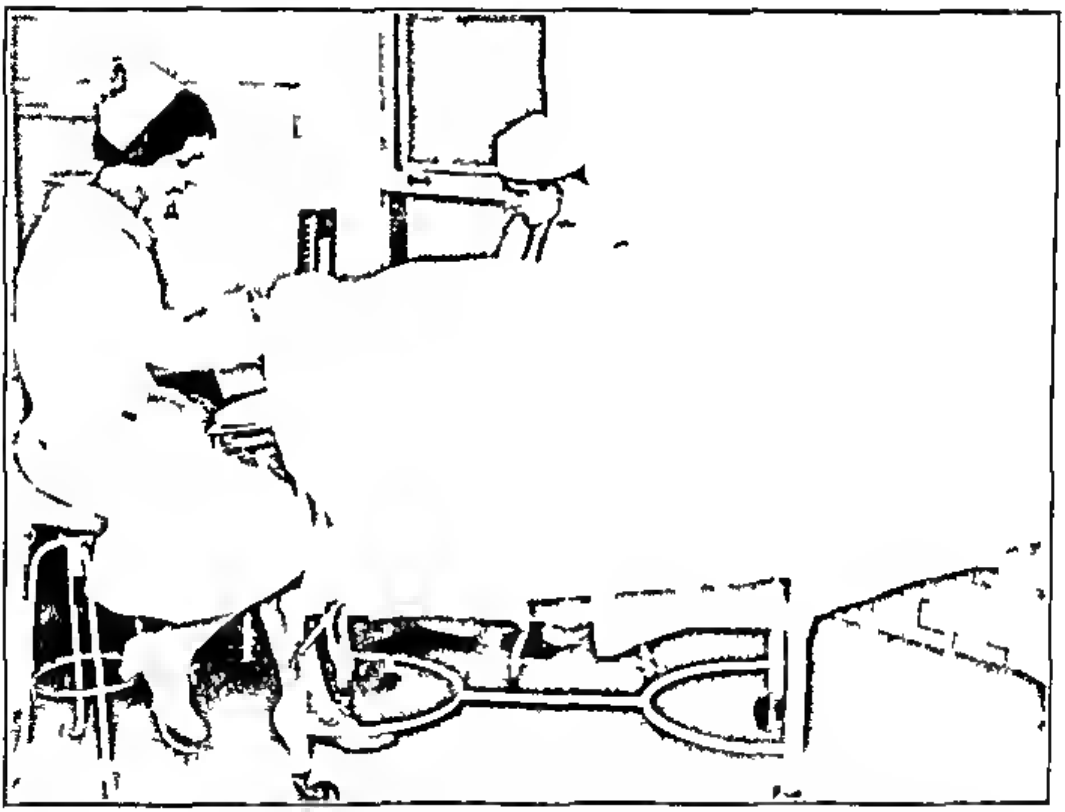

Fig 78 — After turning the patient on his back the head should be lowered the assistant places himself to take blood pressure readings at short intervals and a nurse should sit at the patient s head The nurse is placed there to observe the respiration and to encourage deep breathing if needed

The patient is quickly turned flat on his back and allowed to lie level for a few minutes until the anesthesia level has become established The head is then lowered approximately 15 degrees and remains in this position during the operation The assistant takes his place at the blood pressure apparatus and a nurse sits at the head of the patient (Fig 78) The latter can aid greatly in making the anesthesia a success by keeping

the patient's attention from the operation A moist towel is placed across the patient's eyes If he sleeps he is not disturbed If he talks it is the nurse's duty to occupy his attention

The operation may begin at once for lower abdominal operations, the time consumed to prepare and drape the patient being sufficient to allow the anesthesia to become fixed It requires an interval of fifteen or twenty minutes for gall bladder and kidney anesthetic levels to be reached For kidney operations the patients are maintained on the side to be operated on for ten minutes The height of anesthesia should be determined by pricking the midline of the abdomen with a needle It should be remembered that pressure sense is often present in the upper region of the anesthesia when motor and pain sensation is absent, and one must be sure the patient's response to the needle point is from pain and not anticipation of pain brought on by feeling the pressure of the needle point, as is sometimes the case

During the first fifteen minutes the blood pressure should be taken every two minutes After this every five minutes is sufficient Alarming symptoms if they occur, appear within fifteen minutes after administration of anesthetic or any time that traction is made on abdominal viscera

Complications and Treatment

Rapid change in position, raising the head, tug on viscera by the operator, and even overanxiety of the patient all tend to produce nausea Change of the patient's position should always be made with steady, gentle movements and the head should at all times be kept flat on the table During operation a forceful pull on the viscera will often result in nausea and a fall in blood pressure which is usually transitory If preliminary medication has not been sufficient to allay the patient's excitement, nausea is often present Cold wet towels to the forehead and throat and a few deep breaths will overcome this

Falls in blood pressure are frequent during the course of abdominal operations, and nausea associated with this is relieved by an injection of 3 to 5 minims of adrenalin Such drops may be as low as 70 or even 60 and should cause no

undue alarm if they occur suddenly and during the manipulation of the organs Keeping the table level predisposes to drops in blood pressure and lowering the head alone will frequently overcome it

It is the gradual drop in blood pressure beginning soon after injection of the anesthesia and continuing without remission that should be watched closely If it reaches 70, three or five minims of 1 1,000 adrenalin solution should be injected subcutaneously This may be repeated It will usually suffice to bring the blood pressure near normal A second injection of ephedrine is not advisable It has the tendency to aid in maintaining blood pressure but not to raise it once it is lowered

In bad risk patients, those suffering from shock or when the anesthesia has been established too high, a sudden collapse of blood pressure and stopping of respiration may be seen shortly after injection of the anesthetic These complications are rare We have witnessed collapse of blood pressure twice but respiration has never ceased They necessitate immediate action on the anesthetist's part An incision should be made on the ulnar side of the cubital fossa so as to expose the beginning of the brachial vein and 5 minims of adrenalin should be injected into the vein No attempt should be made to put the needle into the vein through the skin, since the veins are collapsed under such conditions and only loss of time will result Massage of the forearm toward the shoulder aids in carrying the solution to the heart In our experience we have not seen such means fail to produce an almost immediate rise in blood pressure Artificial respiration would be necessary until this injection had been made and was effective, if respiration had stopped A syringe and ampules of ephedrine and adrenalin are always at hand for this emergency

Patients with amputation neuromas in the lower extremity often suffer severe pain immediately following spinal anesthesia The cause for this is not understood We have seen three such cases, two requiring general anesthesia for relief

Primary Low Blood Pressure

Under ordinary circumstances blood pressures as low as 90 do not contraindicate spinal anesthesia with the usual technic

If the blood pressure is under 90, 50 mg of ephedrine and 3 minims of adrenalin injected intravenously before bringing the patient to the operating room will raise the blood pressure well above 100 The patient should then be treated in the usual manner, including a subcutaneous injection of 100 mg ephedrine previous to the injection of spinal anesthesia

Children

Children who have reached approximately adult height should be anesthetized in the same manner as adults Younger people require dosage of novocaine in proportion to size, but it must be remembered that the conus medullaris lies at a lower level in younger individuals Thus the spinal puncture should be made relatively lower Injection in the third interspace for those younger is a good rule

Failure to Establish Anesthesia

Occasionally the anesthesia will not be established sufficiently high After fifteen minutes there is no contraindication to a second injection, and 100 mg of novocaine should then be used; this is almost always enough to raise the anesthesia to the desired level

Postoperative Care

As soon as the operation is finished, the patient is removed to the bed slowly on a cart arranged so that the head is kept lowered The foot of the bed is raised on twelve inch blocks and maintained so from six to eight hours for abdominal surgery Three hours are sufficient for perineal surgery

Postoperative Complications

Headache is the most frequent postoperative complication but is one we rarely see unless an unruly patient gets up the day after a cystoscopic examination The lumbar puncture headache comes on in the first twenty four hours after the anesthetic is given and is usually occipital or parietal in location It is worse when the head is raised and diminishes when it is lowered Diagnostic lumbar puncture may produce it when nothing is placed in the spinal canal It is supposed to be due

to leakage of spinal fluid into the extradural tissues Prevention is accomplished by the use of small lumbar puncture needles with short beveled ends by making one puncture only and that in an absolutely quiet patient to avoid tearing the dura

In treating keep the head lowered for a longer time than is customary and prescribe aspirin or pyramidon This controls all mild cases For a severe case in addition force fluids avoid excitement and give 1 c c surgical pituitrin or 50 mg ephedrine intramuscularly For a persistent headache 100 c c of 5 per cent saline intravenously may be given

This headache must be differentiated from a meningitis headache which comes on several days after operation and is associated with stiff neck photophobia and sometimes paralysis of external rectus muscle This is a rare complication and we have had no cases of it

All apparatus must be scrupulously clean besides being aseptic and no air should be injected into the spinal canal

Nausea and vomiting may be psychic may be due to to cerebral anemia to sudden change in the position of the patient or may be one of the symptoms associated with lumbar puncture headache or meningitis The cause must be determined and appropriate treatment instituted

Nerve injuries to nerve and cord are possible but we have never experienced one If actual trauma to nerves occurs the damage is likely to be permanent Trauma produced by a hematoma would be temporary Proper technic of spinal puncture is the only preventive

Paralysis of the abducens nerve has been reported Especial susceptibility to the drug by this nerve is claimed but not proved Its long passage through the spinal fluid subjecting it to irritation from air bubbles or foreign bodies into the spinal canal or to hemorrhage into spinal fluid is given as cause for this complication It usually occurs about ten days after operation and may last several weeks but clears up spontaneously

Backache may occur from trauma to vertebral periosteum in spinal puncture It is usually relieved by external application of heat and placing a small pillow under the lumbar region

Anal and vesical incontinence has occurred in a very few cases but always disappears spontaneously in a few days

Psychic disturbances have been fairly frequently reported in neurotic and apprehensive patients An estimate of the patient's reactions is obtained during the history taking and physical examination We then discuss the question of anesthesia with the patient, and if he states that he prefers ether, he is given ether, however, most of the patients prefer or wish to be given spinal anesthesia

CHAPTER XVII

OPERATIONS ON INGUINAL AND FEMORAL HERNIAS

Operations for hernia have been done under local anesthesia more frequently than any other operation of like magnitude The reason for this is that this operation can be done with ease because of the definite anatomic relations of the structures involved The patient is often desirous of escaping the general anesthetic, the disadvantages of which have been unduly magnified by those irregulars who pretend to produce a cure by non operative means Many patients indeed have refused operation until they find that it can be done without a general anesthetic It is surprising, too, that many physicians who have long borne the inconvenience of their hernias submit to operation when they once observe the efficiency of local anesthesia While the most frequent reason for employing local anesthesia is that it causes less inconvenience to the patient, in a few patients, particularly those of advanced years, operation may be advised under local anesthesia where general anesthesia would be prohibitive

All hernias may be operated under local anesthesia Simple inguinal hernias furnish suitable objects for the introduction of the beginner into the use of local technic, while some of the large scrotal or interstitial ones furnish good exercise for the experienced technician It becomes necessary, therefore, for the operator to measure his experience with the particular case before him if he is to avoid perplexities and disappointment for himself and pain to his patient In the following description the operations are given in detail in order that the junior surgeon may anticipate the possible difficulties at the various *stages Despite the recent development of spinal anesthesia*, local infiltration is still the anesthetic of choice

Neural Anatomy

The nerve supply in the region of inguinal and femoral hernias is furnished by the **ilioinguinal, iliohypogastric** and genitocrural nerves (Fig 79)

The ilioinguinal nerve arises from the first lumbar nerve and passes across the quadratus lumborum muscle, pierces the trans

versalis muscle and, associated with the iliohypogastric, follows the curve of the crest of the ilium It pierces the internal oblique muscle in front of and above the anterior superior spine of the ilium and reaches the inguinal canal by following Poupart's ligament under cover of the fascia of the external oblique In the canal it lies upon the cord at its anterior and upper surface and is the first object to come into view when the canal is opened It escapes the canal at the external (medial) ring and supplies the skin of the upper inner part of the thigh and the

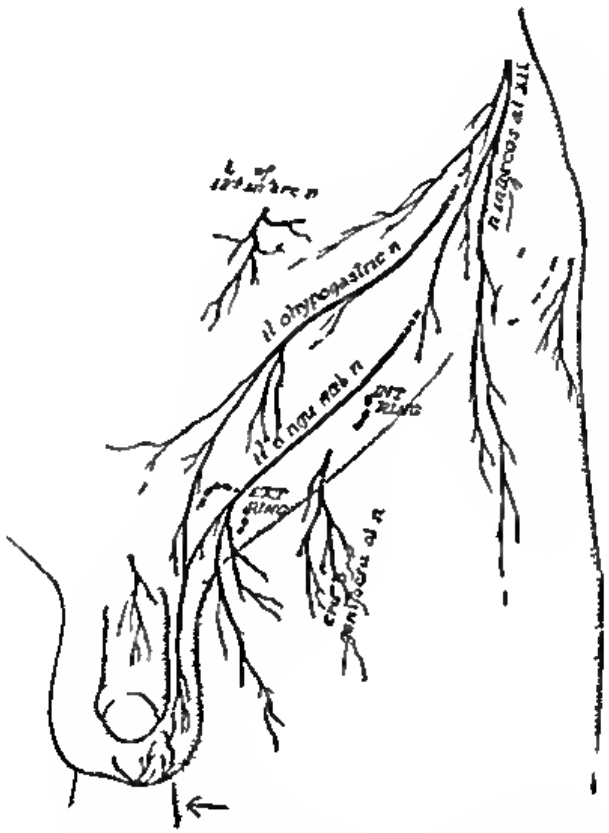

Fig 79 —Nerve supply of the inguinal region

upper part of the scrotum, and the root of the penis in the male and the extreme upper part of the labium majus in the female It usually lies as a white band the size of a thick darning needle upon the hernial sac Occasionally it divides before entering the canal and is then spread out into a number of fine filaments

The iliohypogastric nerve, like the preceding, arises from the first lumbar nerve and passes along the crest of the ilium in company with it Before reaching the anterior superior spine of the ilium, it divides into an iliac branch, which passes over the crest of the ilium and is of no interest in this connection,

and a hypogastric branch which continues in company with the ilioinguinal At or near the anterior superior spine it parts company with its companion and reaching the under surface of the fascia of the external oblique, passes between this fascia and the internal oblique muscle to a point about an inch above the external (medial) ring where it pierces the fascia and is distributed to the neighboring skin

The important point in the relation of these two nerves is that at a point 3 or 4 cm above and medial to the anterior superior spine and over the crest of the ilium beyond, they lie close together and may be blocked at this point (Fig 79) by an anesthetic solution

The genitocrural nerve, formed by the union of fibers from the first and second lumbar nerves, runs on the surface of the psoas muscle under cover of the peritoneum to reach the outer side of the external iliac artery Here it divides into a crural branch, which, accompanying the iliac vessels, pierces the fascia and supplies the skin about the saphenous opening, and a genital branch which accompanies the spermatic vessels through the inguinal canal and supplies the scrotal contents and after piercing the spermatic fascia supplies the cremaster muscle

In many instances this nerve is fused with the ilioinguinal When such is the case the blocking of this nerve secures anesthesia of all the scrotal contents Frequently the nerve divides into numerous filaments which are distributed to the cord In most instances the vas secures fibers high up in the canal so that if the cord itself is to be attacked the whole cord must be blocked

In addition to the above described nerves, branches from the pubic and small sciatic nerves supply the posterior surface of the root of the scrotum The upper part of the scrotum is probably supplied by nerves from the sacral plexus, as well as by the nerves above described This arrangement of the nerves makes it necessary in large scrotal hernias particularly in those containing strangulated omentum to block the skin and fascia about the root of the scrotum as well as the nerves in the inguinal canal

Novocaine epinephrine ½ per cent is the most convenient solution to use In extensive cases ¼ per cent may be used for the

deeper structures In very large hernias this may be supplemented by quinine solution, or the latter may be used throughout.

Inguinal Hernia

Either of two plans may be followed in the operation for the radical cure of inguinal hernia I The operation as first developed by Cushing consisted in the successive infiltration and division of the various layers, together with a direct injection of the ilioinguinal nerve after it was exposed II Preliminary wide infiltration of the field of operation, thus blocking off all the nerves before the operation is begun

The first operation, now seldom used, demands a more exact technic and requires less anesthetic fluid than the plan of nerve blocking The beginner will find that his attempts at blocking will often fail at some point and it is of importance at such times to know just how to supplement it by secondary injections For this reason the technic by nerve blocking will be supplemented by information as to the methods to follow when nerve blocking fails to procure complete anesthesia

Preliminary Nerve Blocking—In this method the entire nerve supply is blocked at the point where they lie most closely together, namely above and medially to the anterior spine (Fig 79)

The line of the skin is first infiltrated (Fig 80) beginning at a point medial and above the anterior superior spine and extending to a point a fingerbreadth below the external ring Most beginners make the mistake of not carrying their incision low enough over the pubes At the point of beginning a needle is passed in the subcutaneous fatty tissue superficial to the external oblique fascia (Fig 81) If the subcutaneous layer is abundant, it is well to pass the needle in several places in order that the nerve twigs following the vessels may be reached This done the needle is nearly withdrawn and passed downward again beneath the external oblique fascia infiltrating well the inguinal canal as it passes downward The fluid comes in direct contact with the ilioinguinal nerve as it lies on the hernial sac

Supplementing the above, it is well to infiltrate the muscles beneath the point of beginning in order to block the nerves

where they lie within the muscles (Fig 82) Likewise it is well to infiltrate over the pillars of the external ring Sometimes twigs from the twelfth dorsal nerve reach this point By using

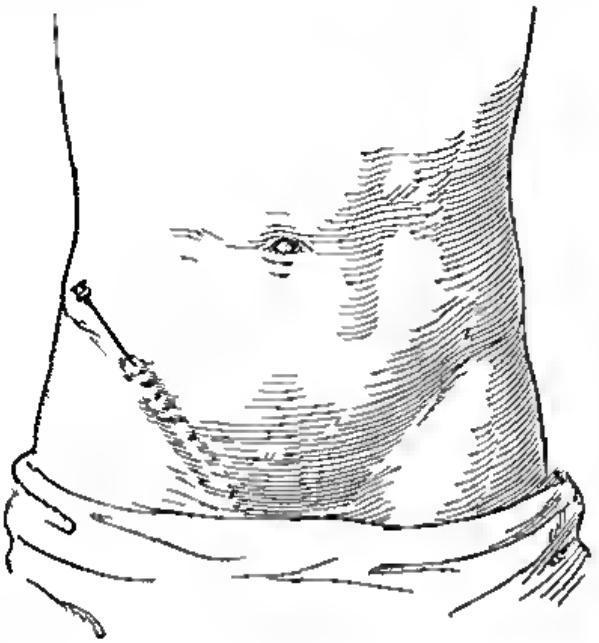

Fig 80 —Preliminary skin infiltration made directly over the inguinal canal

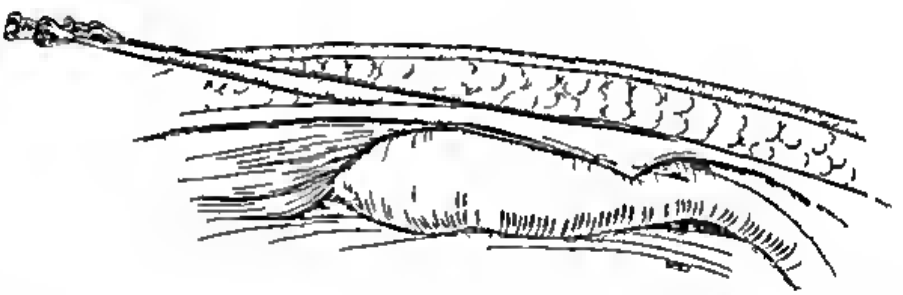

Fig 81 —The needle is passed first superficially to the external oblique and then beneath it directly within the inguinal canal

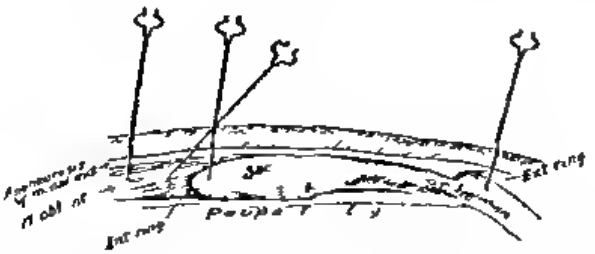

Fig 82 —Schematic transverse section of the inguinal canal Needles correspond to *A B, C,* Fig 80 reaching the ilioinguinal and hypogastric nerves the structures about the internal ring, and the structures about the pillars respectively

these supplemental injections one may begin the operation as soon as the injection has been completed

Sometimes after the sac has been exposed, the ilioinguinal nerve is still sensitive In such cases the nerve may be directly infiltrated (Fig 83) Likewise the cord may be sensitive to

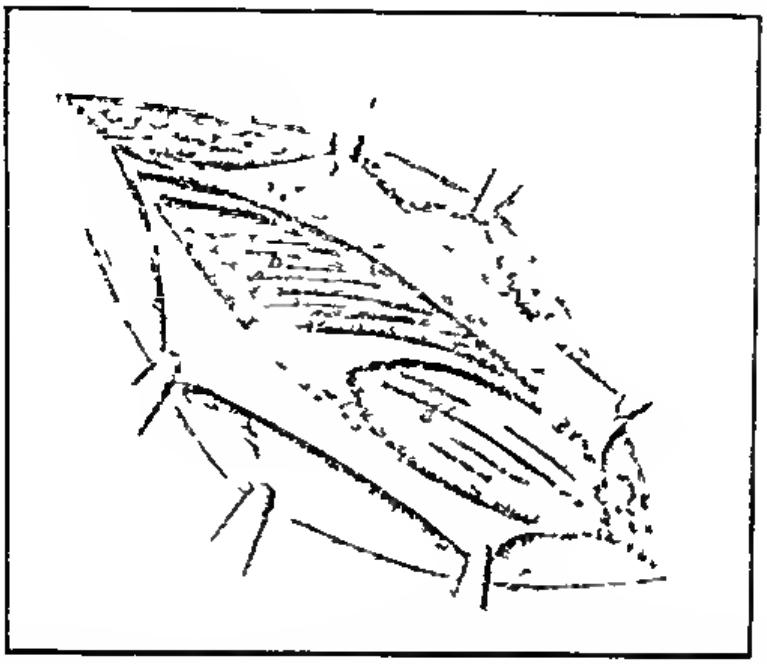

Fig 83 —The fascia of the external oblique is incised and the edges are caught up by forceps and retracted In the depths of the wound the cord and sac are exposed showing the nerve at the summit *a*, Infiltration of the ilioinguinal nerve at its exit from the internal canal, *b*, infiltration of the muscle necessary only when the muscle is incised to permit greater displacement of the cord.

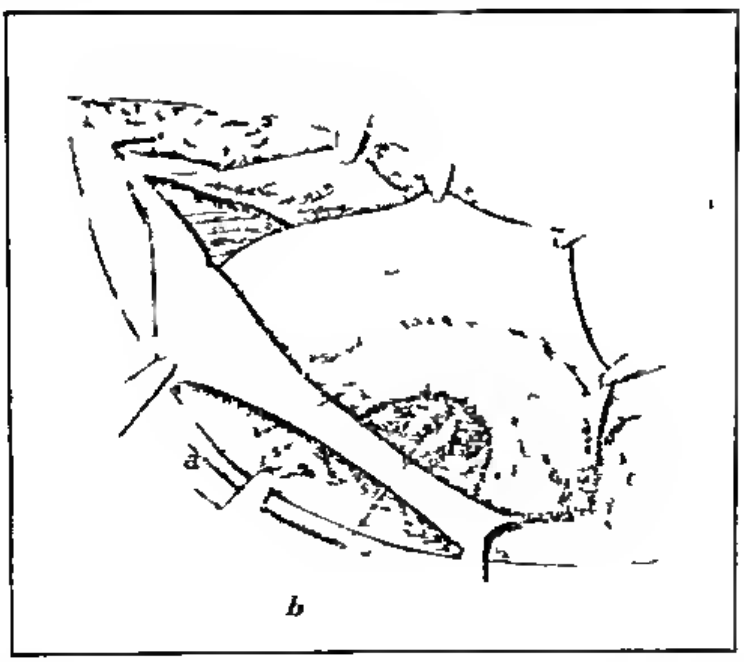

Fig 84 —The cord is lifted from its bed with forceps The sac shows above, and below is the cord including the vessels and fat. *a*, Point for injecting the cord; *b*, deep epigastric vessels

traction as one attempts to elevate it from its bed Infiltration directly into it (Fig 84) will allow this manipulation to be done without pain

Strangulated Inguinal Hernia

In cases of strangulation the problems depend upon the degree of inflammatory reaction present In early cases the operation differs in no wise from operations on patients in which

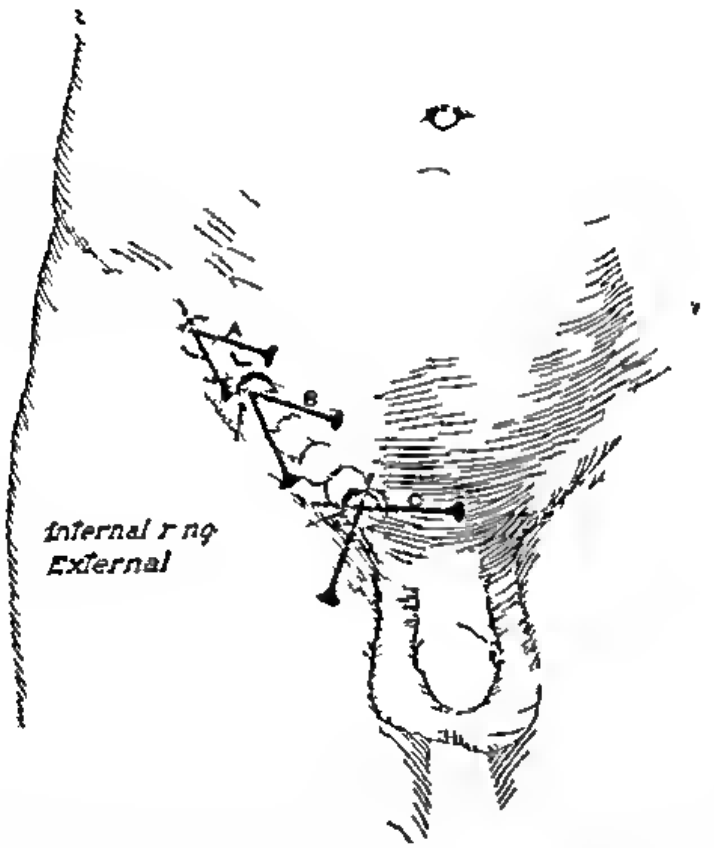

Fig 83 Nerve blocking for inguinal hernia *A* Deep infiltration into the abdominal muscles to block the ilioinguinal and hypogastric nerves *B* infiltration about the internal ring to anesthetize the attachments of the sac *C* infiltration about the pillars to block accessory and aberrant nerve filaments

strangulation has not occurred save that the infiltration is made about the inguinal canal and not into it for fear of puncturing the gut At a point medial to the anterior superior spine the deep infiltration is made The needle is passed obliquely upward and outward (*A* Fig 83) The fascia of the external oblique is felt as a definite resistance to the needle

In cases in which the tissue is very edematous the action of the anesthetic is interfered with and it is preferable to infiltrate layer by layer After the sac is exposed the tissues about the internal ring are separately injected (Fig 86), and may then be incised with impunity Strangulated loops of gut are not sensitive and may be handled without pain Above the line of strangulation sensitiveness may be heightened

Strangulated omentum, if it has retained its vitality in good measure and has become adherent to the sac, produces pain

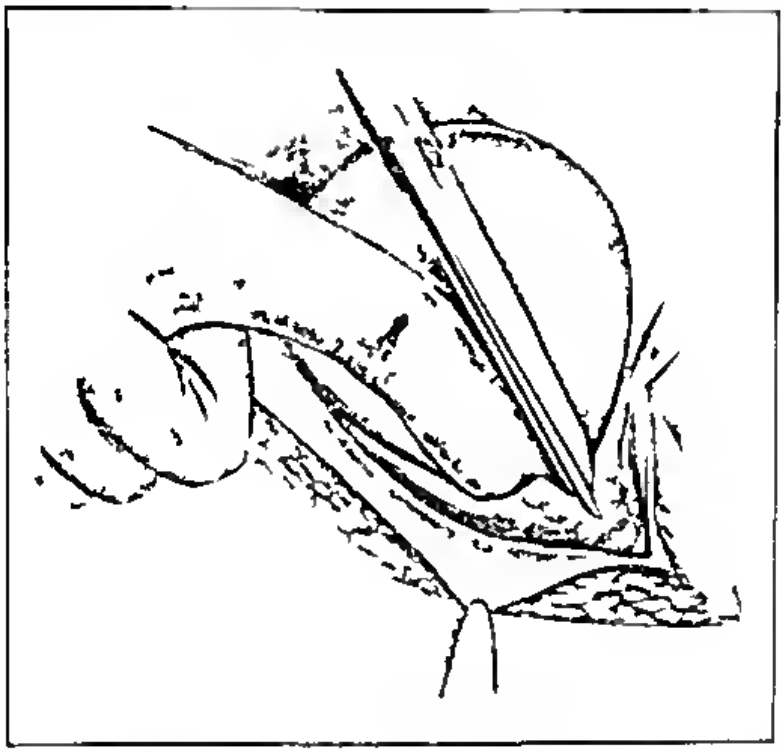

Fig 86—The sac containing the strangulated gut is exposed and the constricting ring is identified with the finger and is being cut with the scissors The dotted lines show the lines of infiltration

when manipulated Topography is likely to be distorted so that accurate localization is uncertain The entire field about the internal ring must, therefore, be blocked off preferably with ½ per cent novocaine epinephrine solution

The use of local anesthesia does not alter the surgical problems involved If the gut is viable, it is returned and the operation terminated by complete or partial closure If necrotic, the gut is fixed in the wound to be resected at a later date or the resection and anastomosis may be proceeded with at once

Femoral Hernia

The neural anatomy of femoral hernia is such that nerve blocking cannot be employed, and dependence must be placed upon infiltration without regard to the nerve distribution

An elliptical skin line is infiltrated about the hernia with a linear extension upward and outward parallel with Poupart'

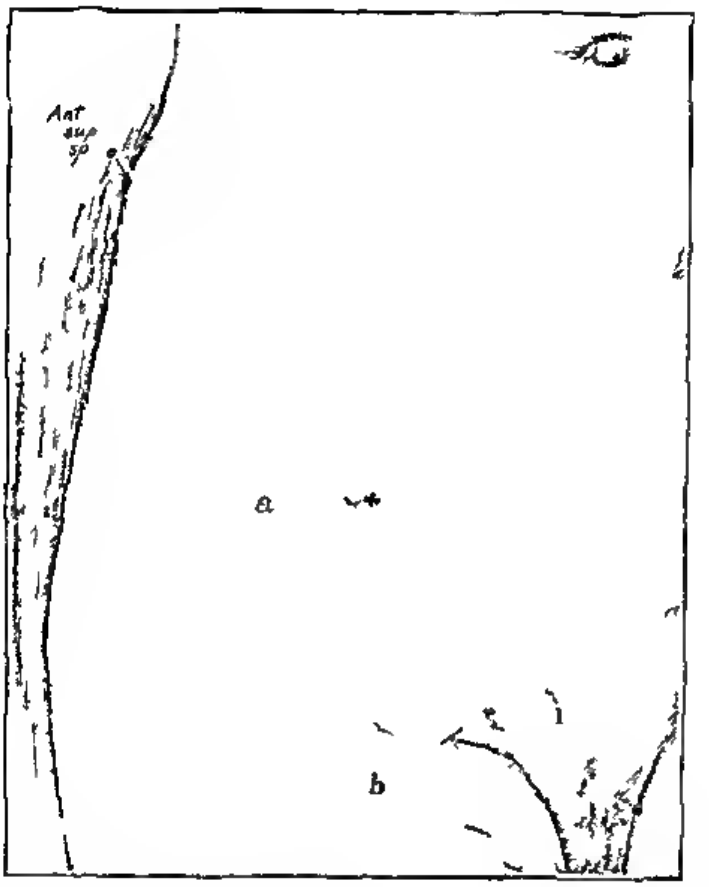

Fig 87—Skin infiltration about a femoral hernia *a* Point of entrance for infiltration about the neck of the sac This point reaches the crural branch of the genitocrural *b* point for infiltration medial to the sac reaching the pudic nerves

ligament (Fig 87), or downward parallel with the saphenous vein The former is suitable for the performance of Selig's operation and the latter for conventional operations with or without strangulation

From the initial infiltration line in the skin the tissues about the tumor are injected (*a* and *b*, Fig 87) The medial side can be infiltrated with impunity, but the close proximity of the

femoral vein to the lateral side demands caution in passing the needle Anesthetization of the neck can usually be accomplished by passing the needle through the lower edge of Poupart's liga ment If Seelig's operation is to be performed, anesthetization of the inguinal canal as described for inguinal hernia should be added

CHAPTER XVIII

OPERATIONS FOR UMBILICAL HERNIAS, HERNIAS OF THE LINEA ALBA AND SCAR HERNIAS

The operations dealt with in this chapter require usually an exact technic and a large amount of solution Umbilical hernias lend themselves better to operation under local anesthesia than scar hernias because the anatomic problems are the same in all cases, varying in difficulty only as the size of the hernia and the adiposity of the individual Scar hernias, on the other hand, are complicated and their exact extent can never be foretold The hernia itself may be larger than anticipated and the omental adhesions about the scar may be extensive The character of the previous operation gives some clue Hernias following prolonged drainage or operations following operations by inexperienced operators present the most difficult problems Local anesthesia is the method of election in umbilical hernias, but unless there is some reason for using local anesthesia, general or spinal anesthesia is best for scar hernias The usual indication for local anesthesia is in scar hernias of one's own making which it is desirable to obliterate by attracting as little attention as possible Patients are usually grateful for our efforts because knowing the effects of general anesthesia they appreciate having escaped a repetition of its discomforts

Umbilical Hernias

Umbilical hernia is most common in stout women past middle life who are poor subjects for general anesthesia Besides, with local anesthesia the postoperative vomiting is eliminated The following operation has been found uniformly satisfactory in all patients for hernias of any type or size

I formerly used quinine urea hydrochloride for the anesthetization of the skin in these extensive operations in order to lessen the amount of novocaine used However, 3 or 4 ounces of novocaine solution is sufficient for these operations and this is well within the limit of safety

The cutaneous nerves and the nerves supplying the rectus fascia are the chief ones to be considered The former are man

aged by cutaneous infiltration, while the latter are best controlled by infiltration of the recti muscles which carry the nerves.

An ellipse is infiltrated about the hernia at such a distance from the sac that it is easily accessible (Fig 88). If it is desirable at the same time to excise superfluous fat, the ellipse must be correspondingly wider and larger (Fig. 89). I have in this way resected pieces of fat measuring a foot in one diameter and eight inches in the other, with a thickness of four inches. The fatty layer should be injected through the primary line of infiltration.

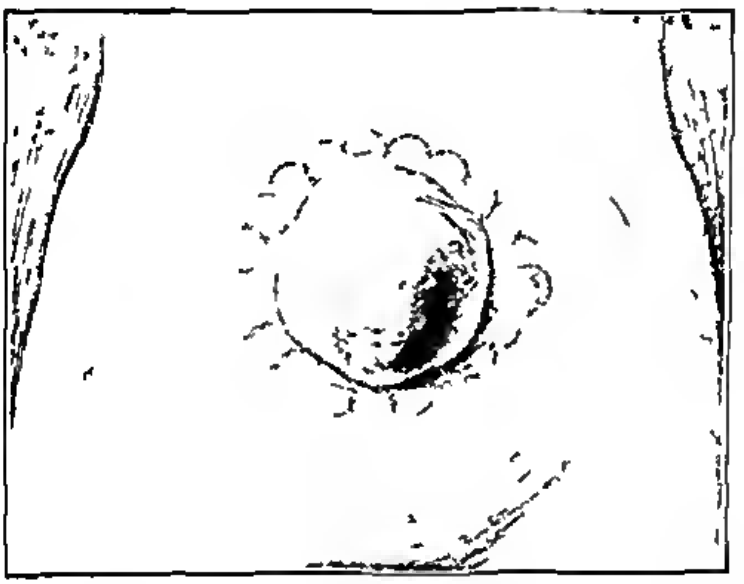

Fig 88.—Line of infiltration about a small umbilical hernia

No set plan can be followed in infiltrating the fat layers. That nearest lateral side of the base of the hernial sac at the point where the fibrous septae are most numerous is the most sensitive. Usually 5 to 10 c.c. of the solution may be advantageously deposited here

If the operator is experienced and the abdomen not too fat, the abdominal walls may be anesthetized through the primary line of infiltration before the skin is incised The fascia about the ring is freely infiltrated (Fig. 90). Considerable experience is required to detect the moment when the needle touches the fascia. Usually a sense of resistance is experienced and usually there is a momentary contracting of the recti muscles. It is

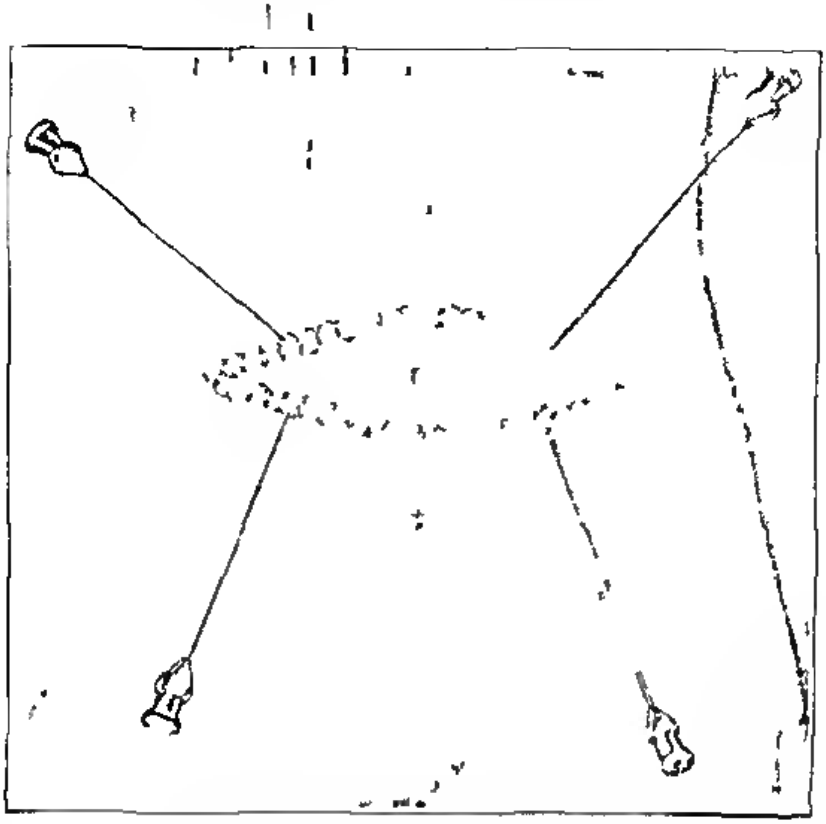

Fig 89.—Elliptical line of infiltration for large hernia. If lipectomy is to be done, the ellipse must be larger.

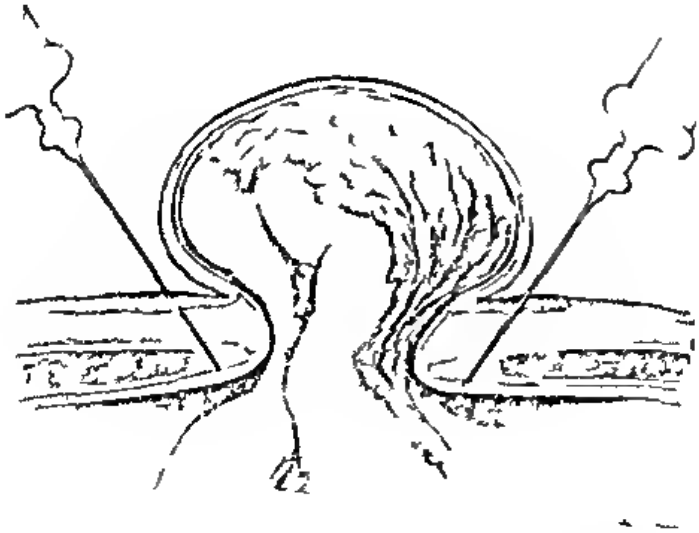

Fig. 90.—Infiltration of the layers of the abdominal wall in umbilical hernia. The skin has not been incised. (Redrawn from Braun.)

desirable to detect the first contact of the needle with the fascia in order that some anesthetic may be injected above it The needle is then passed through the fascia into the body of the muscle This injection anesthetizes the surrounding perito neum Usually about 5 c c are required at each of four points If these injections are well made complete anesthesia is secured about the sac

If conditions are less favorable, the following plan is more certain, the skin is incised through the primary infiltration line and the fascia is exposed, as shown partly accomplished in Fig

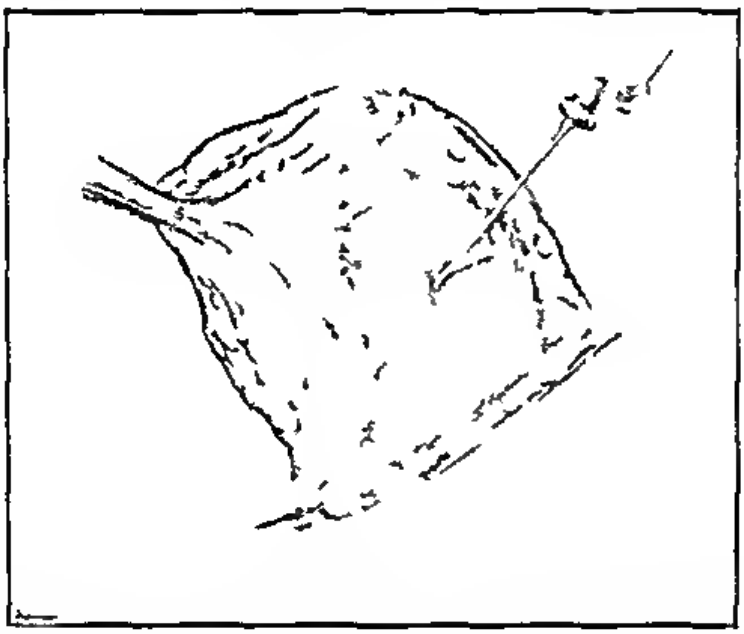

Fig 91 —Infiltration of the fascial layer of the abdominal wall in umbilical hernia Half the circumference of skin and fatty layer has been incised and raised up showing the point of entrance for the needle in injecting the fascia, mu cle and peritoneum.

91 The abdominal *wall* about the *ring* is *then infiltrated* (*Fig* 91), fluid being injected just beneath the fascia, into the muscles and particularly just above the transversalis fascia The dis tance from the ring at which the injections should be made de pends upon the size of the opening If it is large, or if exten sive overlapping of the edges of the ring will be required, the injection should be made at least an inch from the margin If the opening is small, the injection should be made close to the ring (Fig 91) By this injection the ring is effectually anes thetized for all future manipulations

The sac is now opened and adhesions of omentum and gut are freed from the ring and from each other Any excess of omentum is excised and the cut edges are carefully inverted to prevent subsequent adhesions

The flaps are now prepared for overlapping Any degree of imbrication is possible and there is no rigidity of the muscles or increase in intraabdominal pressure when the sutures are passed if the anesthesia is perfect The usual Mayo technic may be followed, or the overlapping may be done laterally

Hernia of the Linea Alba

The small hernias of the linea alba nearly always occupy the midline and are exposed best through a line infiltrated directly over their summit In the rare cases of hernia of the linea semilunaris, the line of infiltration corresponds to the lateral border of the rectus It is well to make the primary infiltration much longer than the apparent need, so that if the hernia has a long pedicle, which is not uncommonly the case, it will not be necessary to make a second infiltration in order to reach it

After the primary line has been infiltrated the external fascia is anesthetized by injecting the tissues immediately above it The operator readily perceives when the needle touches the fascia, and if he does not, the patient will tell him After the prefascial tissue is injected the needle passes through the fascia into the edge of the rectus muscle This region is freely infiltrated in order to anesthetize the tissue external to the transversalis fascia The entire region of the operation is then anesthetized If the operator cannot find the fascia, the skin and subcutaneous fat may be incised first, and the fascia and deeper layer infiltrated when exposed as described under umbilical hernias

Any operation desired may be done As suggested above, it is well to make a fairly long incision into the abdomen to determine the relations of the pedicle to the interior of the abdomen

Scar Hernias

A bulging scar presents much the same problem as an umbilical hernia, but is likely to be more complicated Unless the

operator is quite sure of himself, he should carefully consider beforehand the nature of these complications

The chief difficulty in operating on scar hernias is the uncertain extent of the sac Usually the sac overlaps the abdominal

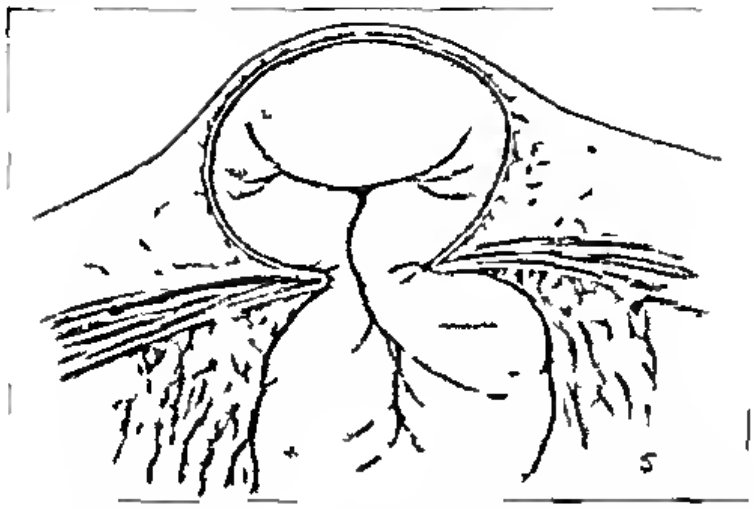

Fig 92 —Diagram of a cross section of a scar hernia showing the overlapping of the muscle wall by the sac The lines of infiltration are calculated to include the redundant skin

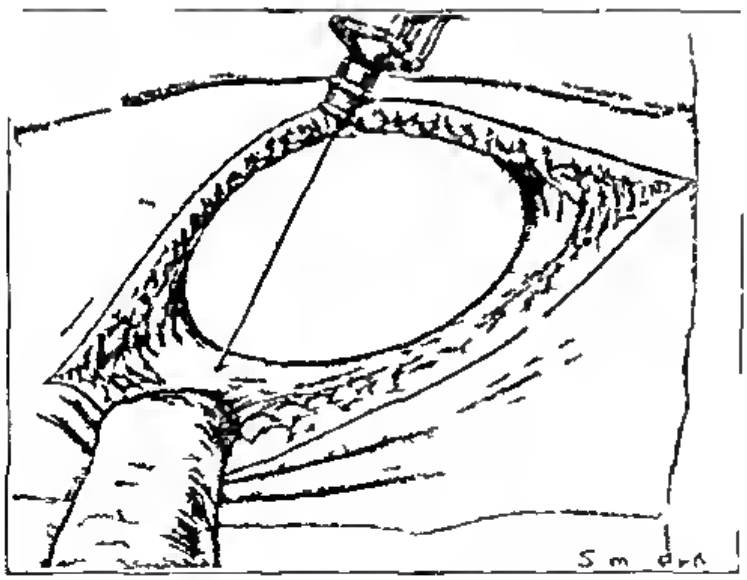

Fig 93 —The fascia about the base of the sac is infiltrated after the skin and fat layer have been incised

wall about the opening by a wide margin It is necessary to secure anesthetization of the entire region so covered The extent may be determined best by examining the patient in the standing position

After the extent of the sac has been determined an elliptical line is infiltrated which includes the entire scar If there will be redundant skin after the hernia is reduced this must be taken into account (Fig 92) The incision is then made down to the fascia of the abdominal wall Through this line (Fig 93) the fascia, muscle and peritoneum are infiltrated The infiltration must extend far enough away from the edge of the hernial opening to include the area which is likely to be occupied by adhesions of the omentum and intestinal coils (Fig 94) If this is not done, pain will be caused when they are separated

From this point the problem is the same as when operating under general save that the abdominal wall is pale and flaccid

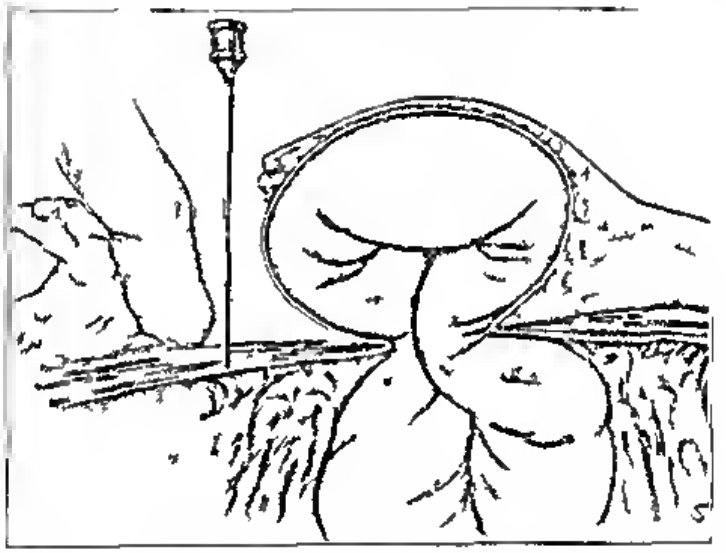

Fig 94 Diagram showing the manner in which a scar hernia overlaps the hernial ring Adhesions surround the hernial ring The area of infiltration must include this entire area

from the novocaine epinephrine For this reason the operator must use more than ordinary care not to cut adherent intestine *in opening the abdomen*

If, when the opening is exposed, it is found too large to allow direct apposition a flap of the adjoining fascia must be loosened and turned over the defect Additional infiltration must then be made in the area from which the flap is to be taken

Lipectomy

Patients unduly plump often desire to be relieved of the redundant fold commonly formed just above the pubes Some

times this can be combined with the operation for the cure of umbilical hernias Otherwise the site for the incision may be elected to circumscribe the fold Generally speaking this includes an ellipse 6 by 15 inches in extent Infiltration of the skin, and to a certain extent of the subcutaneous fat, is all that is required By this means one may rid the patient of a very irritating fold of fat and skin with no risk and little discomfort

CHAPTER XIX

OPERATIONS ON THE PENIS AND THE SCROTUM AND ITS CONTENTS

All operations on the male genitalia can be easily performed under local anesthesia because nerve blocking is simple and certain though the nerve supply is somewhat complicated Only in amputation of the penis with inguinal dissection is spinal anesthesia a rival Three sets of nerves must be kept in mind in all major operations in this region, the cutaneous nerves in the pubic region, the ilioinguinal, the nerves of the cord, the genitocrural and the long perineal supplying the perineal region and the lower part of the scrotum

Operations on the Penis

Circumcision —Removal of the redundant foreskin is usually the operation which furnishes the first lesson for the beginner in local anesthesia Simple as the operation is, careful technic is required in order to avoid many annoyances during its course and afterward The operation, therefore, will be described with more than usual detail

The foreskin is supplied by the dorsalis penis nerve which enters the dorsum at the root and sends out branches which supply both the cutaneous and the mucous surfaces

A rich plexus of veins lies between the skin and the mucous surfaces and at the frenulum is an artery which always requires ligation Smaller and less constant arteries are found on the dorsal or lateral aspects

The usual error in circumcision is that the skin is anesthetized but the mucous membrane is neglected The frenulum, too, sensitive as it is, is often overlooked The skin is too thin to permit endermic infiltration, and subdermic injection must be depended on

With the foreskin in its normal position a line ¼ to ⅓ inch wide is infiltrated just back of the corona of the glans (*A*, Fig 95) Some care is needed in order that a perfect circle is described

The foreskin is then fully retracted and a line is injected in a like manner in the mucous membrane about ¼ inch proximal to the corona glandis (Fig 96) The frenulum is then injected from the line in the mucous membrane to the glans (Fig 97)

Amputation of the Penis—Carcinoma presents practically the only indication for amputation of the penis The inguinal

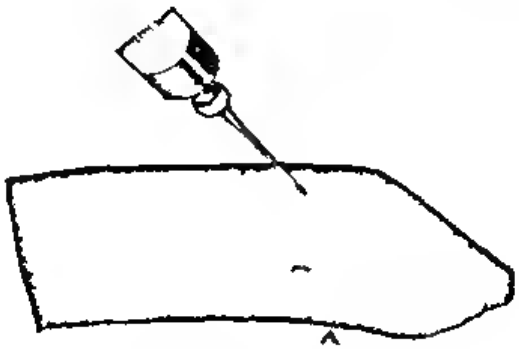

Fig 95 Line of skin infiltration made when the foreskin is in its normal position.

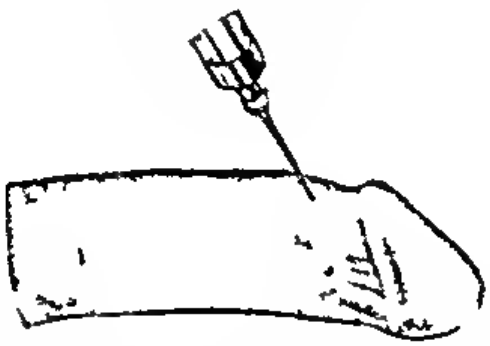

Fig 96—Infiltration of the inner surface of the foreskin made when it is fully retracted

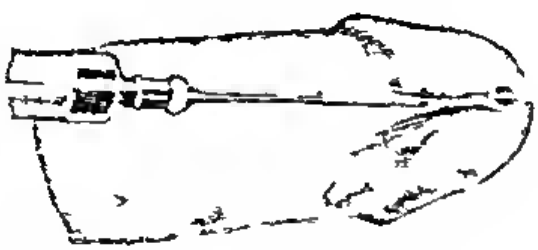

Fig 97—Injection of the frenulum

glands require preliminary removal in all instances It is convenient, therefore, to begin the anesthesia by injecting the inguinal canal This is accomplished by infiltrating a line from a point a short distance medial to and below the anterior superior spine, continued along the direction of the inguinal canal, crossing above the pubes and describing a line along the opposite inguinal canal (Fig 98) From this primary line the deeper

Fig 98.—Line of infiltration for amputation of the penis and removal of the inguinal glands. At the points x x the tissue about the root of the penis is infiltrated.

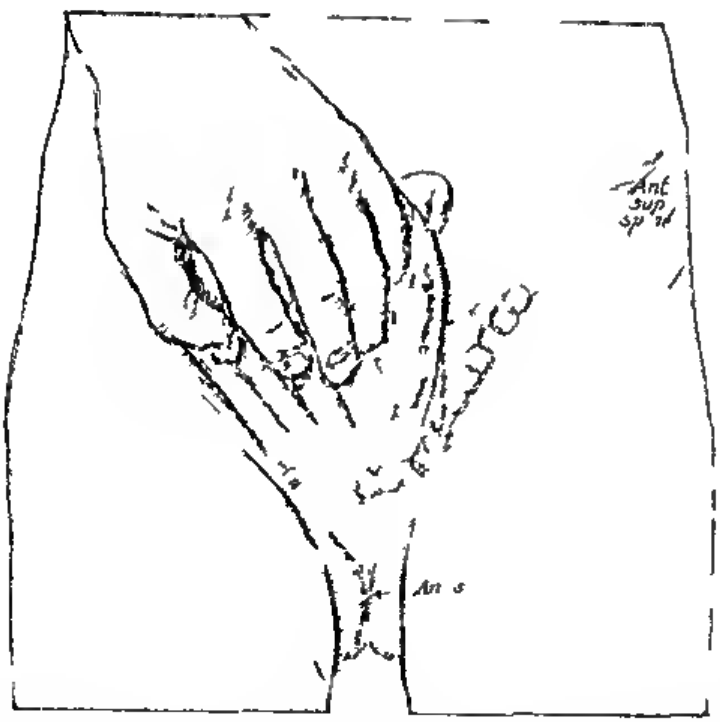

Fig. 99.—Line of infiltration about the root of the scrotum. The deep tissues are injected at the points x x. The transverse line shown in the previous figure is shown in the background.

tissues are infiltrated as for hernia, also about the root of the penis (a, x, Fig 98) The region of the external abdominal rings receives particular attention The cord must be effectually blocked as in operations upon the cord The scrotum is now raised and the skin across the root of the penis is infiltrated from one side to the other (Fig 99) The root of the penis is now infiltrated by passing the needle medial to the pubic arch, reaching the dorsalis penis at the root of the penis beneath the arch (a, x, Fig 99) This is the most important point of injection and several cubic centimeters of the fluid should be deposited in the vicinity of the nerve At the same time an excess should not be injected A surgeon of my acquaintance had the misfortune to have a gangrene of the penis following the very tense infiltration with a strong anesthetic solution Generally speaking, 5 c c is about the right amount This done, the entire penis and scrotum, together with the contents of the latter, is anesthetized and any operation required may be done

Operations on the Scrotum and Its Contents

All operations on the scrotum should be done under local anesthesia as the method of election These are the simplest of all operations to perform under local anesthesia

Nerve Supply—The scrotum is supplied by the ilioinguinal nerves at its upper part and by the perineal nerves at the lower portion The scrotal contents are innervated by the genital branch of the genitocrural and the sympathetic nerves from the aortic, renal and hypogastric plexuses Because of the abundant nerve supply to the scrotum, incisions into it are best preceded by injections into the line of the proposed incision The nerve supplying the scrotal contents may be blocked in any part of the cord This may be most easily done just below the external ring

Varicocele—Operations for varicocele have for their object the obliteration of the veins of the pampiniform plexus, varicosities of which constitute the prominent objective symptom of the disease The requirements of the operation in any given case will depend upon the conditions present If the scrotal relaxation is marked, this requires attention If the vessels

alone are affected, the resection of these only will give the desired result The ideal operative scheme must be such that each of these may be given the attention the conditions present demand The operation here proposed has the merit that both factors in the disease may be given attention through a single small incision

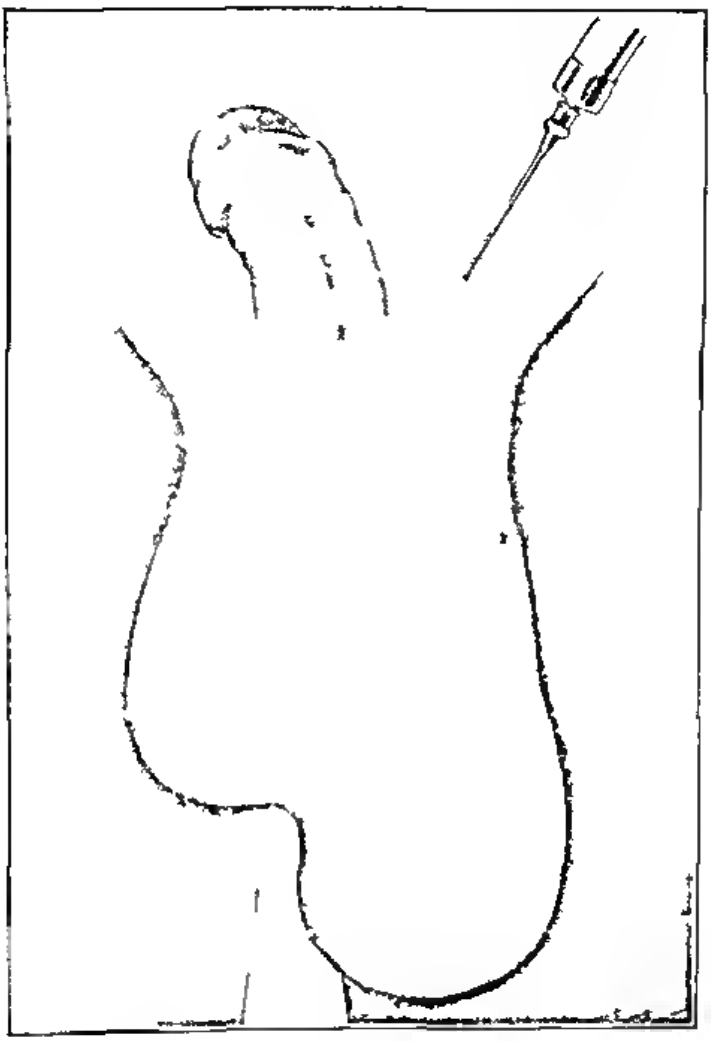

Fig 100—Line of skin infiltration

Beginning immediately below the base of the scrotum a line is infiltrated in the general direction of the cord (Fig 100), extending downward 1½ inches This anesthetizes the cutaneous nerves only, which, it will be remembered, are branches from the sacral plexus through the perineal nerves The scrotal contents are supplied by the nerves accompanying the cord through the inguinal canal At the point of operation they have divided

into branches too fine to be infiltrated directly. Perineural blocking must, therefore, be resorted to. This is done by grasping the cord between the thumb and finger at the base of the scrotum and making firm pressure (Fig. 101). The needle is passed at the upper end of the line already infiltrated into the

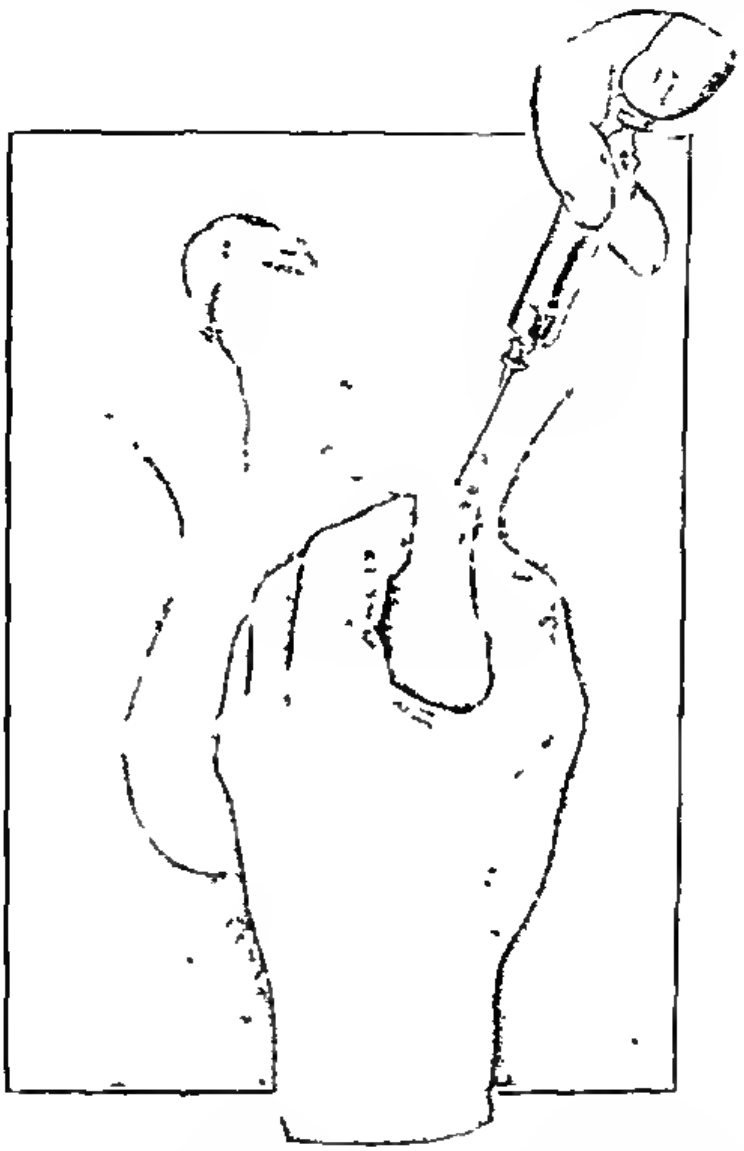

Fig 101.—Method of grasping the cord for blocking of its nerves

tissues imprisoned between the thumb and finger. About 2 c.c. (30 minims) is injected at this point This effectually blocks all the nerves leading to the scrotal contents.

Instead of injecting the cord through the unopened skin, the cord may be separated after the incision of skin and tunica has been made; then grasping it between the thumb and finger, the

operator can make the injection accurately This method is more easily accomplished but the separation of the cord before injection is accompanied by some pain

Amputation of the Scrotum—If preferred, the classical amputation of the scrotum may be performed Ordinarily the degree of shortening is estimated and the distance determined is clamped off with long bladed forceps Moynihan's intestinal forceps are excellent for this purpose The skin below the forceps is then infiltrated with quinine or novocaine epinephrine, and the amputation proceeded with, the clamps being still in position Through and through sutures are then placed and tied

Since the shortening of the tunica alone is of importance and the removal of the skin incidental and unimportant, the clamps are best avoided, because when they are placed, the tunica is liable to retract and the purpose of the operation is defeated The following method, therefore, is to be recommended as permitting the operator to remove with greater exactness the desired amount of the tunica

The amount of the scrotum to be amputated is estimated by drawing the redundant portion between the fingers If the operator doubts his ability to follow the imaginary line so formed it will be well to paint a line with tincture of iodine This line is then anesthetized about the entire circumference of the scrotum The skin is cut through to the tunica with scissors The tunica is then taken up and the amount to be removed estimated by drawing it between the fingers The tissue is anesthetized while the grasp is retained The portion representing the intertesticular septum should receive special attention because nerves are abundant at this point The excision of the redundant tunica is then completed, care being taken to secure the sac from retraction Any bleeding points are caught up and ligated as they are cut Careful hemostasis should now be made in order to secure every bleeding point Otherwise, postoperative hemorrhage into the sac will cause embarrassment during convalescence The two layers of the tunica are united with catgut The skin is then united as a separate layer, preferably by nonabsorbable sutures Since hemostasis has been accomplished by separate ligatures the skin sutures should be

only tight enough to secure apposition of the skin Care on this point will greatly shorten the period of convalescence from the operation

Hydrocele—In the radical operation for hydrocele the same skin infiltration is employed as in the varicocele operation; but it is placed lower, and may be lengthened with advantage The incision is made through the skin down to the tunica vaginalis The cord is exposed above the tunica and loosened carefully with finger and forceps until it can be grasped between the thumb and finger The injection is then made as in varicocele The cord may be infiltrated before making the skin incision as in varicocele if the tunica is not so large as to make the cord inaccessible to the grasp of the fingers

With the infiltration of the cord, the entire area becomes insensitive and the tunica can be separated with ease and the desired resection made Care must be taken to make the separation just external to the tunica, for if the separation is made between the skin and the dartos, pain will result, because the skin of the lower scrotal region is supplied by the perineal nerves, which are unaffected by the anesthetization of the nerves accompanying the spermatic cord For the same reason, if it is desired to drain the base of the scrotum, the skin must be anesthetized at the desired point of incision For the ordinary hydrocele operation a drain is not required An interrupted nonabsorbable suture, after all hemorrhage has been controlled, should be used to close the wound

Castration—The removal of the testicle is the simplest operation upon the external genitals to be performed under local anesthesia *The technic required* consists merely in exposure and ligation of the cord This may be accomplished at the base of the scrotum or in the inguinal canal In the former location the technic is identical with the first steps of the operation for varicocele and in the latter situation the cord is approached as in the operation for inguinal hernia

The site of the incision will be dependent upon the condition requiring castration If the lesion is local, as in hematocele, exposure of the cord at the base of the scrotum is to be preferred Castration, however, is usually done for malignant disease

In that instance, deep infiltrations about the inguinal canal, as for large inguinal hernias, give the best access to the field The entire thickness of the abdominal wall must be infiltrated, preferably through the unopened skin If this is not possible the skin and subcutaneous tissue are infiltrated and the incision is then made to the fascia of the external oblique The remainder of the abdominal wall is then infiltrated This latter plan is the more certain for beginners The inguinal canal is then freely incised and the cord followed under the peritoneum If the castration is being done for tuberculosis the vas may be followed to the bottom of the pelvis The bloodless field secured by the epinephrine is particularly gratifying when working deep in the pelvis

Vasectomy—The section of the vas is done to prevent propagation of the species It is now confined to the sterilization of criminals in some states, but the signs of the times seem to indicate that it may soon have a wider application

The vas, being covered only by the skin and the tunics of the cord, is easily reached Grasped by the thumb and finger, either in front of, or behind the scrotum, it is infiltrated with novocaine epinephrine solution The vas is exposed with a few strokes of the knife The vas is then infiltrated with a few drops of the novocaine solution This is necessary because of the density of the coats of the vas, diffusion is slow and if the vas is not thoroughly anesthetized the patient is liable to experience a sickening feeling when it is severed A section of the vas an inch long is resected and the ends are allowed to retract If the deferential artery is cut, it must be carefully ligated The tunics of the cord are very vascular and careful hemostasis is required if annoying infiltration of the scrotum is to be avoided

CHAPTER XX

OPERATIONS ON THE URETHRA, BLADDER AND PROSTATE

In this clinic spinal anesthesia has superseded local in the second stage of suprapubic prostatectomy and in perineal operations We use local infiltration in bladder drainage and in all operations in which spinal is contraindicated

Neural Anatomy—The sensory nerves of the genitourinary organs are the same as those of the rectum and anus They are so numerous that blocking of specific nerves is uncertain, and while in a general way the injection may be massed in the direction of the chief nerve supply, dependence must be placed upon infiltration of the entire organ

Local Anesthesia Preliminary to Cystoscopic Examination—Antipyrin and opium and, for local application, cocaine were formerly employed The first has been abandoned because of inefficiency and the last because of its dangers The most efficient safe anesthetics available at the present time are alypin and quinine, either of which may be introduced into the bladder half an hour before the proposed examination The most efficient method, however, is the blocking of the sacral canal which in nearly all cases gives complete anesthesia of the parts involved in cystoscopic examination In intense cystitis with spasmodic contractions of the bladder, sacral blocking is sometimes inefficient since it does not reach the bladder wall nor the peritoneum covering it I have used quinine in the sacral canal but its action is less prompt than novocaine and the effect lasts an unnecessary length of time

External Urethrotomy

This operation is generally required in otherwise healthy subjects in which a general anesthetic is not objectionable When a local anesthetic is desirable, sacral combined with transsacral, or, in irritable subjects, a spinal anesthesia, may be used Any

of these methods may be supplemented by local infiltration This has the added advantage of making the operative field relatively bloodless

Suprapubic Cystotomy

This operation may be required for the removal of foreign bodies from the bladder or as the first stage in a prostatectomy If any considerable intravisceral manipulation is anticipated sacral anesthesia should precede the wall infiltration Even the removal of stone is painful if imbedded

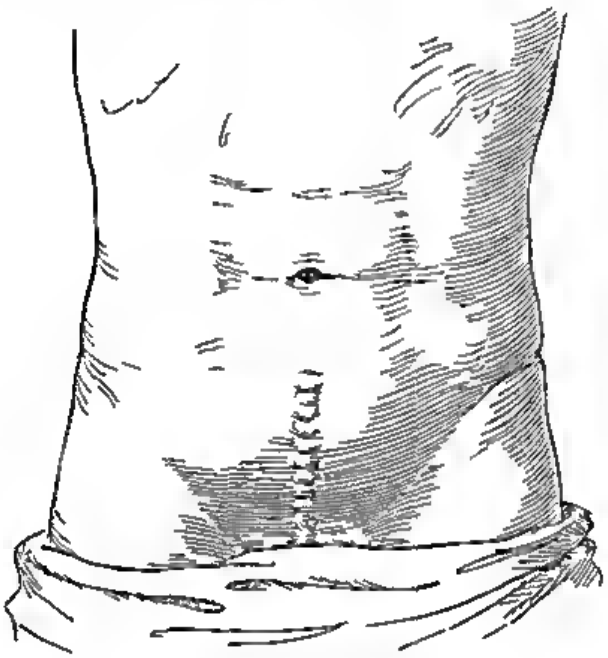

Fig 102—Line of skin infiltration for suprapubic cystotomy

Initial infiltration is made along the linea alba immediately above the pubic bone (Fig 102) The subcutaneous tissue and the external surface of the fascia are anesthetized by passing the needle parallel with the surface (*1* Fig 103) The muscle and peritoneum are anesthetized by passing the needle below the fascia within the substance of the muscle, and over the surface of the peritoneum (*2* Fig 103) The prevesical fat is infiltrated by passing the needle close beneath the pubic bone backward and upward to the surface of the bladder (*1* Fig 104) and then down to the bladder neck to near the prostate and laterally over the bladder wall (*2* Fig 104) The bladder wall can be rec

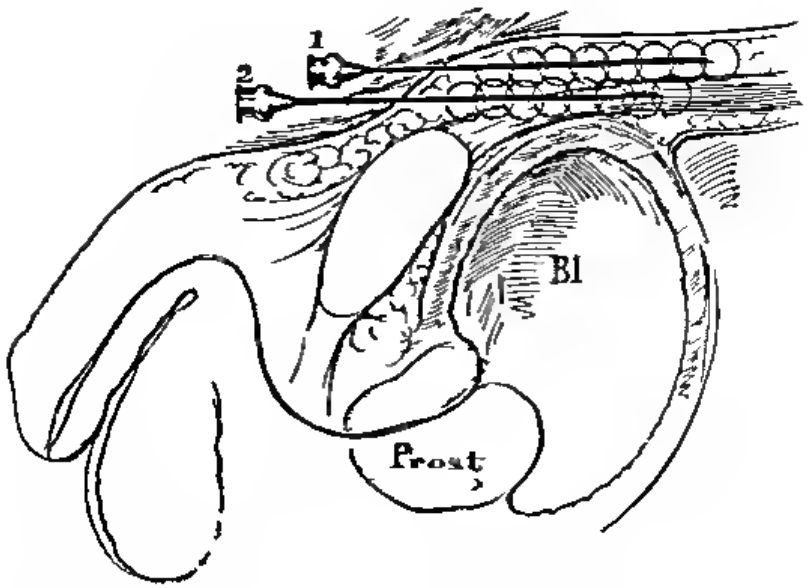

Fig. 103.—*1* The subcutaneous fatty layer and the superficial layer of the fascia are edematized. *2*, by passing the needle beneath the fascia the muscle and preperitoneal fat are infiltrated.

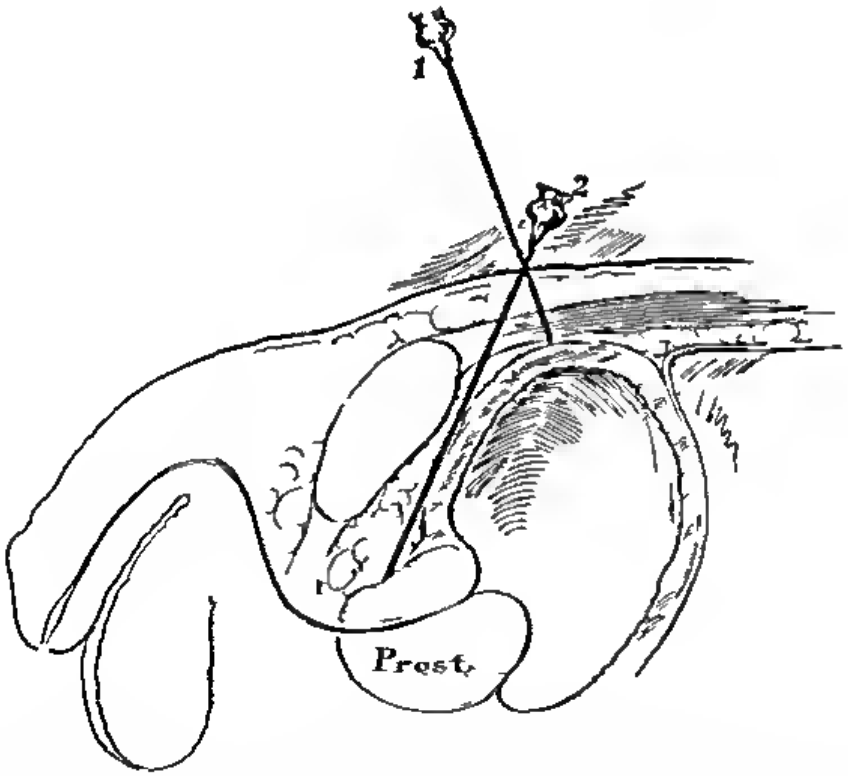

Fig. 104.—The prevesical space is infiltrated by passing the needle down to the surface of the bladder (*1*), then the needle is partly withdrawn and reintroduced obliquely downward and forward as far as the neck of the bladder infiltrating constantly as the passage of the needle proceeds (*2*).

ognized by careful palpation with the needle if the bladder has been previously distended with water

The incision is made along the line infiltrated first down to the bladder wall If, as frequently happens, the wall is still sensitive, it should be fixed with tenaculum forceps and infiltrated separately If the bladder wall is properly injected, it may be cut without pain One may then proceed with the operation indicated, introduction of a drainage tube, extraction of a stone, removal of a tumor or of the prostate

Extraction of Stone—If the bladder mucosa has been anesthetized previously the stone may be searched for and removed without pain If that preliminary has been omitted, the act of grasping the stone may cause pain

Removal of Tumors—After the bladder has been opened as described, the location and extent of the tumor can be seen directly If the tumor is removable, the bladder wall about its base is infiltrated and the tumor removed by excision or cautery The suppression of bleeding by means of the adrenalin makes this part of the operation simple

Stone in the Pelvic Ureter—Stones in the lower portion of the pelvic ureter can be reached by making a transverse incision for the suprapubic cystotomy The prevesical tissue is then freely infiltrated beneath the peritoneum down to the bladder Free injection of fluid about the bladder wall will facilitate separation of the paravesical tissues from it so that the pelvic ureter may be exposed This procedure is difficult and general anesthesia is preferable unless distinctly contraindicated Abscesses deep in the broad ligament may sometimes be reached in the same way

Removal of the Prostate—Many operators now do suprapubic prostatectomies in two steps The first stage consists in a suprapubic cystotomy as already described The second stage consists of the enucleation of the prostate through the suprapubic wound

As a preliminary to this step the suprapubic wound must usually be enlarged For this step simple lineal infiltration extending upward from the opening suffices After the wound has become enlarged the infiltration of the prostate begins Under

guidance of a finger in the bladder a needle is passed anterior to the prostate infiltrating thoroughly the anterior capsule of the gland as far as the urethra (*1* Fig 105) With a finger in the urethra the needle is passed through the gland to the posterior surface of the gland (*2* Fig 105) infiltrating the space between it and the rectum Care must be exercised lest the needle pass into the rectum Finally the lateral capsule is infiltrated (*3* Fig 105) The needle must be passed to just within the capsule (Insert in Fig 105) If the middle lobe is overhanging, the capsule on the posterior surface likewise must be infiltrated

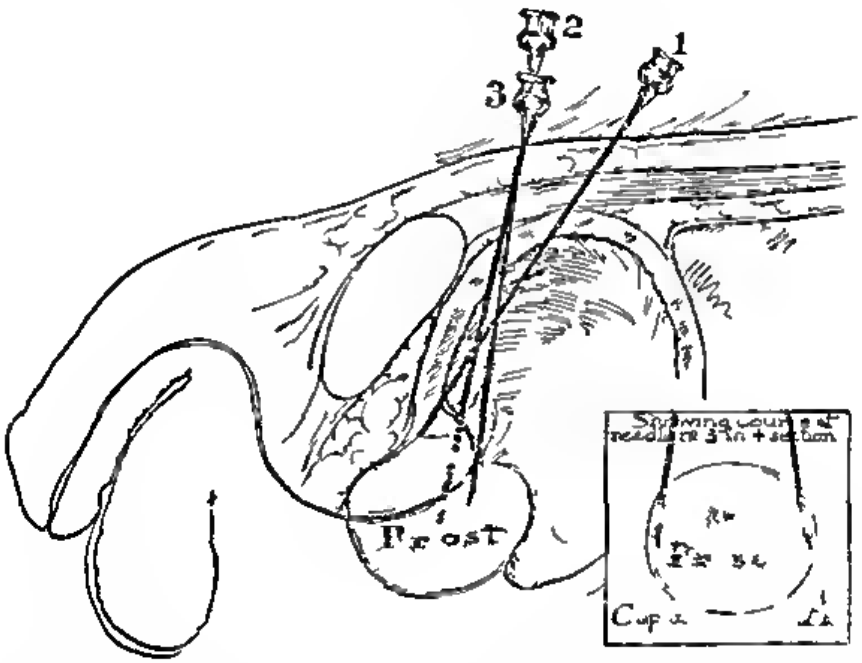

Fig 105—Infiltration of the capsule The space between capsule and the attachment of the ligaments is infiltrated (*1*) next the space between the prostate and the rectum by passing the needle through the prostate by entering the urethra (*2*) and finally the lateral prostate capsule (*3* and insert)

With this done, the enucleation may begin Since in this infiltration the pelvic nerves are not protected against traction, the posterior surface of the gland should be steadied by a finger in the rectum as the act of enucleation proceeds The use of the novocaine epinephrine solution as indicated lessens very materially the amount of blood lost

The technic now used in this clinic is a preliminary sacral together with a transsacral block to be followed after half an hour by the infiltration of the prostate as above outlined

Cystoscopy

For intravesical instrumentation sacral or low spinal anesthesia has been generally employed The new anesthetic diothane applied topically to the urethra and bladder seems to be proving satisfactory for such manipulations Fifteen to 30 c c of one half to one per cent solutions are instilled into the bladder After ten minutes an adequate anesthesia is obtained and the anesthesia is considerably more prolonged than that obtained with other local anesthetics

CHAPTER XXI

OPERATIONS ON THE FEMALE ORGANS

All operations on the pelvic organs can be done without inhalation anesthesia Which method of anesthesia shall be employed depends on the extent of the operation and on other factors to be discussed subsequently Superficial tumors of the vulvar region are best done with infiltration anesthesia The repair of the cervix and perineum may be done with infiltration anesthesia or sacral blocking In major operations on the uterus spinal anesthesia finds its chief field of usefulness

Repair of the Cervix

The cervix is supplied by sympathetic nerves by way of the broad ligaments It is not very sensitive as is readily demonstrated by the common practice of grasping it with tenaculum forceps when making office examinations

The cervix is exposed by a suitable perineal retractor, fixed with a tenaculum and drawn down as near as possible to the vulva The needle is introduced at the line of attachment of the vagina to the cervix, and is passed obliquely upward and medially so as to enter the base of the broad ligament and penetrate the substance of the uterine muscle just below the internal os (Fig 106) Several cubic centimeters of the solution are injected on each side of the cervix and the loose tissue between the cervix and bladder is infiltrated at several points The vagina deflection posterior to the cervix is infiltrated in the same way If anesthesia is not complete an additional injection directly into the angle of the tear may be made, though this is rarely necessary The operation may then begin

Dilatation and Curettage

The use of the curette is not nearly so frequent as formerly among careful surgeons, and it is to be regarded as fortunate that the operation is not readily accomplished by the tyro under

local anesthesia The difficulty lies in the density of the uterine muscles which do not easily permit diffusion of the fluid in sufficient quantity to reach all parts including the peritoneum In the recent pregnant uterus this difficulty does not obtain (one might almost say unfortunately) and curettage may be readily accomplished

Infiltration should begin in the cervix as for repair of lacerations using care to inject deeply into the muscle substance In the nonpregnant particularly in uteri long the subject of

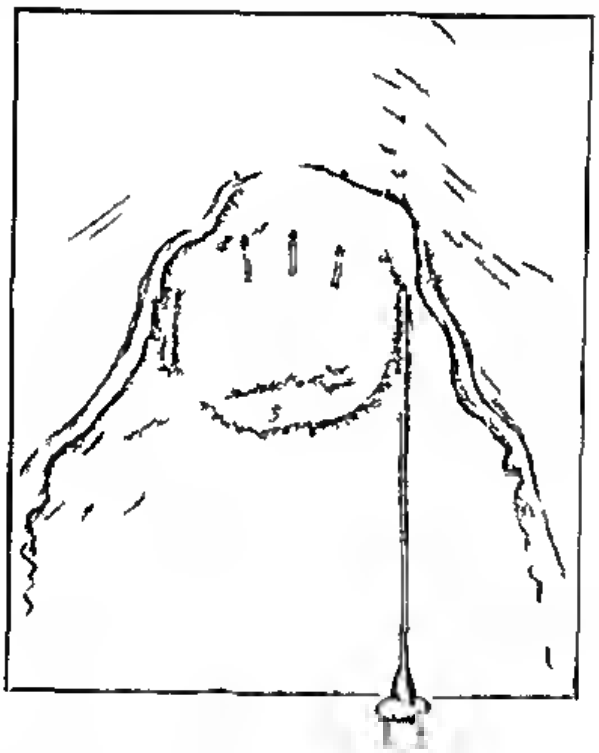

Fig 106—Direction of lines of infiltration for operations on the cervix

chronic inflammation a special syringe such as is used by dentists is desirable In the recently pregnant uterus satisfactory infiltration may be secured with an ordinary syringe If the operator is careful to ascertain the position of the uterus it is easy to inject the body of the uterus through the base of the broad ligament

If after dilatation of the cervical canal the endometrium of the body is still sensitive the cavity may be packed for five minutes with a 5 per cent quinine solution or it may be injected with novocaine by means of a long needle

Anterior Colporrhaphy

Removal of redundant portions of the anterior vaginal wall is easier to perform under novocaine epinephrine than under general anesthesia, because of the lessened bleeding If the cervix does not protrude from the vulva, the infiltration line is begun half an inch behind the meatus (Fig 107) and extends nearly

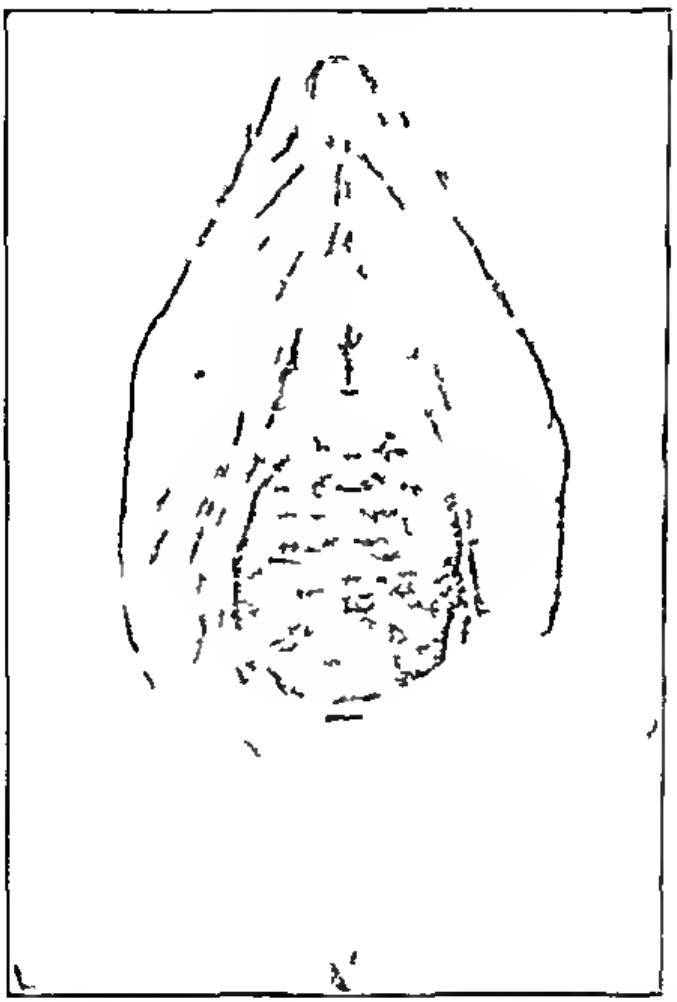

Fig 10 —Infiltration of the vaginal wall in anterior colporrhaphy

to the cervix (Fig 108) From this primary line, lateral lines are infiltrated until the entire tissue between the bladder and the vagina is anesthetized If the cervix comes down into the vulva readily, the infiltration may begin at the cervix and extend nearly to the meatus From this primary line lateral lines are infiltrated as before If other more extensive operations are to be done at the same time quinine may be used for this part of the operation, or very dilute solutions of novocaine epinephrine

In either event an unnecessarily large amount of fluid should not be used because coaptation of tissue will be made more uncertain

The operation as usually done may then proceed

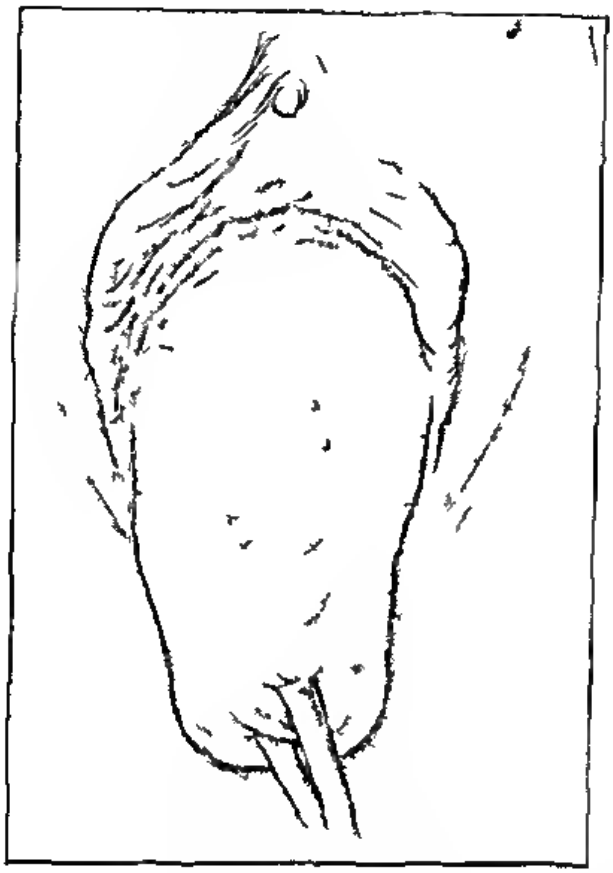

Fig 108.—Method of infiltrating the vaginal wall in anterior vaginal colporrhaphy when the cervix is prolapsed

Repair of the Perineum

When repair of the perineum is to follow any of the operations above described, it is well to begin by infiltrating the perineum By so doing complete anesthesia of the perineum is assured by the time the cervical or other operation is completed and the latter is facilitated by the relaxation of the perineum so induced

Nerve Supply of the Perineum.—The nerves involved in the repair of the perineum are the same as those involved in rectal operations These nerves may be blocked before their exit from the canal by passing a needle at the posterior border of the

tuber ischii in a direction toward the foramen ischii The nerves lie under the ligamentum sacrotuberosum Sellheim prefers to reach the nerves after they have divided into branches by infiltrating the *pararectal space*

When large operations are to be done such as extensive perineal repair, together with rectal operations sacral anesthesia finds its most useful field Even if it does not secure complete

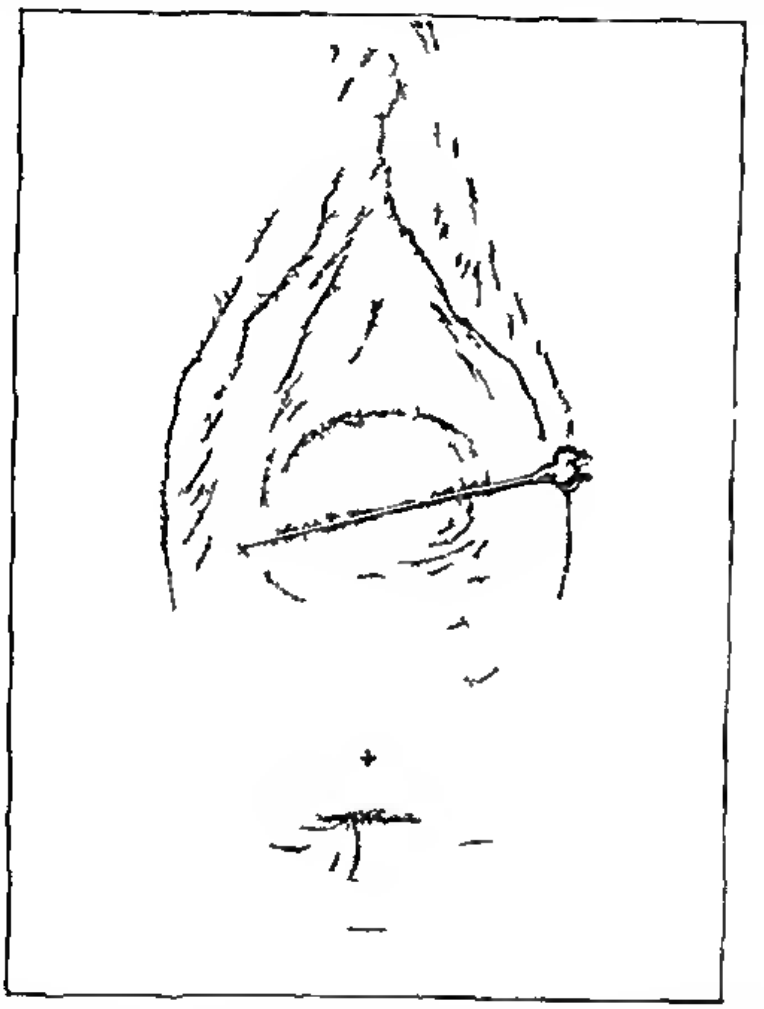

Fig 109—Infiltration of the perineum in perineorrhaphy The infiltration begins at the point marked *x* The needle shows the point of injection of the deeper tissues By directing the needle more directly backward the levator may be reached

anesthesia the deficiency may be supplied by local infiltration The nerves come from so many sources however, that in most cases it is better to depend upon local infiltration, which is *easily done in this region* The *whole* area can be *infiltrated* in less time than is required for the sacral blocking to become effective

Infiltration is begun at the middle of the mucocutaneous junction (Fig 109) and continued along it to the caruncle of each side The region of each caruncle is then grasped by a tenaculum forceps When moderate traction is made upon these the extent of the laceration becomes exposed A line is now infil

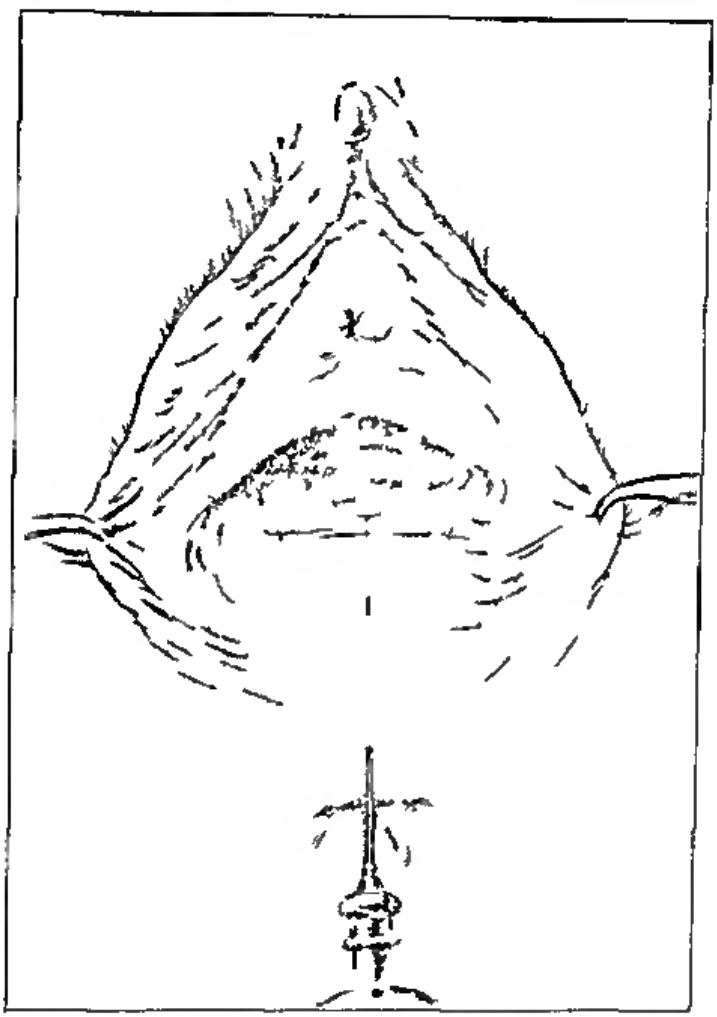

Fig 110 Lines of infiltration of the tissues to guide in

trated from the point of beginning to the highest point (Fig 110) of laceration taking care that the needle is not pushed into the rectum The entire area to be denuded is then infiltrated by a liberal injection of fluid between the vaginal and rectal walls Either anesthetic may be used Novocaine gives less hemorrhage at the time of operation and is advisable for the beginner

Inasmuch as the chief source of discomfort is the pull on the levator muscle, infiltration of this muscle is a most important point A finger in the vagina will locate the levator and determine the point to which the needle should be thrust The muscle itself is infiltrated and the tissue beyond it, both at the level at which the sutures will be passed, and anteriorly toward the pubic bone These tissues are sensitive to the passage of the needle and as much care should be exercised in injecting them as in infiltrating the skin

Operations on the Vulva

Any operation on the vulva, including tumors and incision of the skin for pruritus, may be performed with infiltration anesthesia Either anesthetic may be employed, quinine, if the operator has in mind the after comfort of the patient, novocaine epinephrine if he has in mind his own convenience The same applies to operations upon the urethra

The Freund Wertheim Operation may be done under local infiltration alone, but requires considerable experience both in the performance of the Freund Wertheim operation and in the use of local anesthesia Spinal blocking helps but little and if infiltration anesthesia seems too difficult the operator should proceed at once with spinal anesthesia General anesthesia is, of course, the method of choice If infiltration is to be used, the operation is begun as for exploratory hysterectomy, with the addition that the anterior vaginal wall must be infiltrated and separated as for anterior colporrhaphy Instead of splitting the uterus after the vaginal wall is elevated, the base of the broad ligaments are widely infiltrated with novocaine epinephrine The uterine wall is then infiltrated before an attempt is made to pull it into the vaginal wound This makes it insensitive to the grasp of the forceps and to the subsequent passage of the sutures when it is fixed in the vagina As the uterus is exposed and drawn into the wound, regions higher up may be infiltrated

The only point in the operation presenting any difficulty is the pulling of the uterus into the vagina This is facilitated by having the vaginal wound large enough to permit the pas-

sage of the uterus without undue traction For this reason the bold operator will have less difficulty than the timid one

Before beginning this operation the surgeon should make sure that the uterus is mobile A uterus may be low in the pelvis and yet possess attachments that will make the operation difficult If the uterus is fixed or if the broad ligaments are fibrous as they become after the menopause, spinal anesthesia must be used because the firm traction required under these conditions cannot be made painless by infiltration anesthesia

Vaginal Hysterectomy—The chief difficulty in doing vaginal hysterectomy under local anesthesia is the fact that pulling down the uterus causes pain This is particularly true if there are adhesions or if as after the menopause the broad ligaments are fibrosed In prolapsed uteri in fat old women in whom abdominal fixation seems hazardous hysterectomy under local anesthesia becomes the operation of choice In these cases the broad ligament becomes readily accessible and by a liberal removal of the vaginal wall these patients may be made comfortable with very little risk

Up to a certain point this operation is identical with the preceding The base of the broad ligament is infiltrated more widely lateral to the uterus The posterior culdesac likewise must be infiltrated

Whether or not the perineum will require repair, it is worth while to infiltrate this region as for perineorrhaphy so as to *secure relaxation* and thereby *facilitate very much* the removal of the uterus The manner in which the uterus is removed must be planned to fit the individual case If the uterus is freely mobile ligation may begin at the base of the broad ligament *In more difficult cases the uterus may be bisected as for hysterectomy* and removed in pieces It is possible to remove the fundus, allowing the cervix to remain, performing in this way a supravaginal amputation per vaginam

Hysterectomy under local is a difficult operation at best except in cases of prolapse as above noted and the operator must be skilled before he undertakes it If there is a contraindication to general anesthesia the operator had best proceed at once to spinal anesthesia

Palliative Operations for Carcinoma

Extensive infiltration of the tissue about the cervix is made preferably with quinine Several ounces may be deposited about the affected area without much regard to direction, except to avoid the bladder and the rectum Any palliative procedure may then be employed, such as curettage with acetone after Gellhorn's method, or the actual cautery

Curative operations for carcinoma of the uterus are beyond the realm of local anesthesia It is worthy of note that in many cases palliation under local anesthesia will procure a greater lease of life with less discomfort to the patient than attempts at radical operation under ether This point is not sufficiently appreciated

Shortening of the Round Ligaments—Any of the methods commonly employed in shortening these ligaments may be done

Alexander Adams—In very motile uteri without descensus of the cervix this operation gives good results The technic does not differ materially from that described for the anesthetization of the inguinal canal in hernia The absence of the cord and hernial sac makes care in injecting the canal unnecessary The ligaments are more readily found than under general anesthesia, because of the bloodless nature of the field

The Montgomery, or any other intraabdominal method that may be employed, is generally to be preferred to the operation just described, because the results are more certain and the time required to perform it is less The operation I prefer is a transverse fascial incision with the fastening of the ligaments in both ends of the incision To perform this operation a transverse line is infiltrated in the suprapubic fold The fascia and muscle of the abdominal wall are infiltrated through this line In this way the entire thickness of the abdominal wall may be anesthetized

The same thing may be accomplished less elegantly by making a longitudinal incision into the abdomen

Anterior Fixation

In elderly women the best means of remedying a prolapse is to suture the fundus of the uterus to the anterior abdominal fascia This can be best done with infiltration anesthesia

Momentary pain may be caused when the fundus is pulled up into the wound This is the safest method of operating in the fat, old women in whom this affection is usually found

Urethral Caruncle

This little tumor is of frequent occurrence, and because of the sensitive nature of the surrounding tissue, the operator finds an interesting field for the exercise of technical skill The simplest method of anesthetizing the site of the tumor and the distal half of the urethra is to place a tablet of ¼ or ½ grain of cocaine or two grams of quinine just within the urethral orifice The natural moisture of the parts dissolves the tablet sufficiently to bathe the affected mucous membrane in a concentrated solution of the drug After ten minutes complete anesthesia will have taken place and the tumor may be removed and its base cauterized

Larger tumors in this region may be removed in the same way, by adding to the anesthetization above described an infiltration of the surrounding tissue by passing the needle through the area previously anesthetized by the topical application

CHAPTER XXII

OPERATIONS ABOUT THE RECTUM

Operations about the rectum under local anesthesia have not been popular with general surgeons but have found favor with patients Specialists and general practitioners have been more ready to recognize the merits of local anesthesia than have surgeons The anal region is a difficult field for the employment of local anesthesia Blocking operations, because of the abundant nerve supply from a number of sources, is difficult The area is exceedingly sensitive and the position of the patient during the operation tends to make the operation trying on both operator and patient Any apprehensive movement on the part of the patient adds materially to the difficulties of the operator Nevertheless, when the fundamentals are mastered no other region permits operations of all varieties to be carried out with more satisfactory results to both practitioner and patient Patients are reluctant to submit to general anesthesia for the relief of a condition which does not endanger life and to the inconvenience of which they have by degrees learned to submit with more or less patience Only when actually incapacitated do they readily submit to radical operations under general anesthesia The result of the reluctance of the general surgeon to employ local anesthesia has been to drive sufferers from piles to the advertiser, who has been more ready to accede to the demand for relief without general anesthesia The general practitioner can prevent the deflection of his patient if he will do these operations under local anesthesia Most of the rectal diseases belong to the domain of minor surgery and should be quite within the province of the general practitioner Certainly any man who can repair a recently lacerated perineum should be able to carry out nearly all the operations upon the rectum after he has once mastered the rudiments of anesthesia as applied to this region

Anatomy—A knowledge of anatomy is a necessary preliminary, and that not alone of the nerves but also of the muscles and vascular supply, for nowhere else can complications affecting these tissues be more certainly avoided by anticipating them

Broadly speaking the region in question consists of the termination of the gut canal, the group of muscles surrounding it and the associated vessels and nerves The external sphincter, an elliptical muscle surrounding the outlet, is the most impor

Fig 111—Nerves about the rectum

tant muscle Above it is the internal sphincter which is merely a reinforcement of the circular fibers of the rectum The integrity of these muscles must be retained lest an embarrassing incontinence result Descending from above in the submucous layer are the hemorrhoidal arteries and veins It is from these vessels that postoperative hemorrhage may occur if the technic has been faulty The vessels which approach the anal region through the perirectal space are readily seen during the operation and are as readily controlled The nerve supply for the most part, is chiefly found in the perirectal space Appearing

from either side slightly behind the anal axis are the long perineal nerves and from the depth supplying the lateral and anterior portions are the hemorrhoidal nerves The coccygeal nerve approaches from behind (Fig 111) Descending from above within the wall of the gut are branches of the sympathetic nerves These, like sympathetic nerves in other regions of the intestinal tract, are sensitive to traction None of these structures are surgically fastidious yet they demand a certain respect if the surgeon's relations in his dealings with them is to be at all times agreeable and harmonious

Operations about the anus may be divided into those which may be done without dilatation of the sphincter and those in which dilatation is a necessary preliminary In the former class are ischiorectal abscesses, cutaneous and mixed piles and palliative operations upon prolapsed internal hemorrhoids Those demanding a preliminary dilatation of the sphincter are internal hemorrhoids, fistulas, fissures and all tumors within the gut Although prolapsed internal piles may be operated without dilatation, there is most certain to be some that have remained internal to the sphincter which will likely give rise to trouble at some future date and a recurrence after operation is likely to be recorded against the efficiency of the surgical treatment Therefore, even if one pile is prolapsed and easily within reach of ligation without dilatation, the sphincter should be stretched in order that all hidden nodules may be reached Furthermore, if the prolapsed pile is so operated the pedicle slips back within the sphincter and should hemorrhage occur it is almost certain to be undetected for a long time

Drugs Employed —Novocaine epinephrine gives a good anesthetic and the skill required in the use of this drug is but little, but the after pain is prolonged and intense Diothane gives a prolonged anesthesia controlling the after pain for some days So pronounced is this action that its use is to be *recommended* even when hemorrhoids are removed in the course of major operations in which spinal or general anesthesia is used In such cases it need be injected only into the pedicle of the pile

External Hemorrhoids

External hemorrhoids are formed by the coagulation of blood within the veins of the anal region They are covered by skin not materially changed or at most but slightly inflamed. When the thrombosis extends into the veins of the mucous surface, a mixed variety, the mucocutaneous variety, is obtained. If the submucous veins are extensively involved a prolapsed internal pile may be diagnosticated

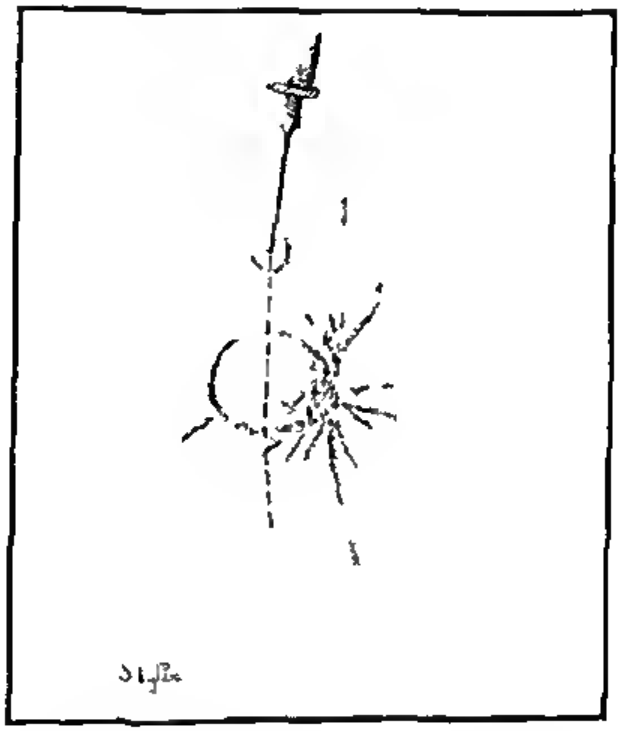

Fig 112.—Infiltration over surface of cutaneous hemorrhoid

If the tumor is confined to the cutaneous surface and the skin over it is but slightly or not at all involved, a line may be infiltrated over its surface (Fig 112) A simple incision is made into its substance and the clot turned out A suture may be placed to control the bleeding; this may be removed after a day or two and healing by granulation permitted In some instances the mere compression by a tampon for a few minutes controls the bleeding and a suture is not necessary

If the skin over the pile is much inflamed or if the thrombus extends into the mucous membrane it is better to infiltrate the

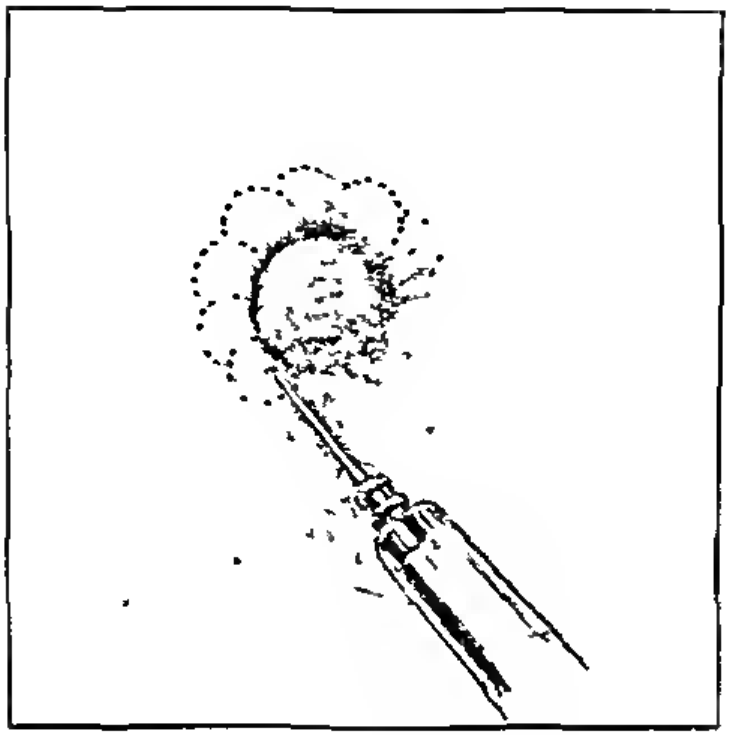

Fig 113.—Inflamed mucocutaneous pile showing line of infiltration in the normal skin about the tumor

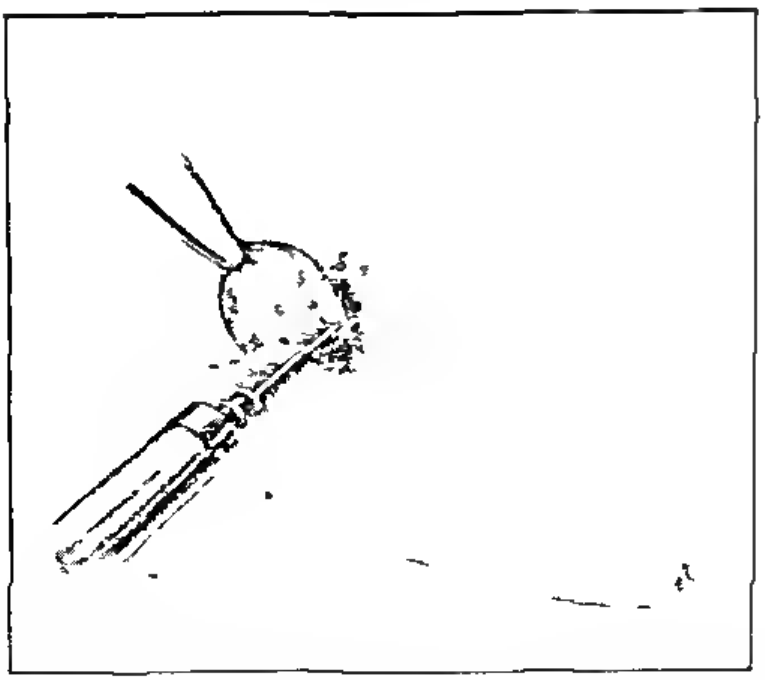

Fig 114.—Prolapsed internal hemorrhoid The skin has been infiltrated in Fig. 113 and the base of the pile is being infiltrated Point for injection of diothane when it is used for the control of after pain only

semicircle is described on one side and then beginning at the original point the opposite side is infiltrated A needle of sufficient length to make sure of penetrating the muscle must be employed A needle is now thrust between the rectal wall and the external sphincter (Fig 116) When the mucosa becomes infiltrated, the sphincter relaxes sufficiently to permit the operation to be done A finger introduced within the anus will assist in guiding the needle to the proper depth to infiltrate the sphincter (Fig 117) If for any reason it is desirable to paralyze the sphincter as in the presence of a fissure, injection directly into the substance of the muscle is made (Fig 118)

Fistula in Ano

The radical cure of anal fistula can be accomplished with surprising ease under local anesthesia My own preference is for an excision of the fistula with the immediate closure of the fistulous tract

Incision of the Fistulous Tract—This operation merely aims at conversion of the fistula into an open wound which shall be allowed to heal by granulation If the internal opening is within the sphincter, the operation may be done without a preliminary stretching of that muscle If it ends high within the gut the sphincter must be dilated

The skin about the opening (Fig 119) and a line from this point to the anal margin within the gut are infiltrated Injections are then made in the deeper portions along the line of the fistula and anal sphincter, and thea in the tissue about the fistula

Because of the scar tissue present, infiltration must be made with unusual care The scar tissue itself cannot be injected and must in consequence he blocked off hy infiltrating the tissue about it (Fig 120) The scar tissue is sometimes very extensive, particularly if the patient has previously been treated by incision or hy the injection of irritating fluids

In extensive involvement of this region hy fistulous tracts it is advantageous to make a sacral blocking with novocaine and use quinine in the field of operation wherever it is needed to supplement the sacral blocking and for the purpose of controlling after pain

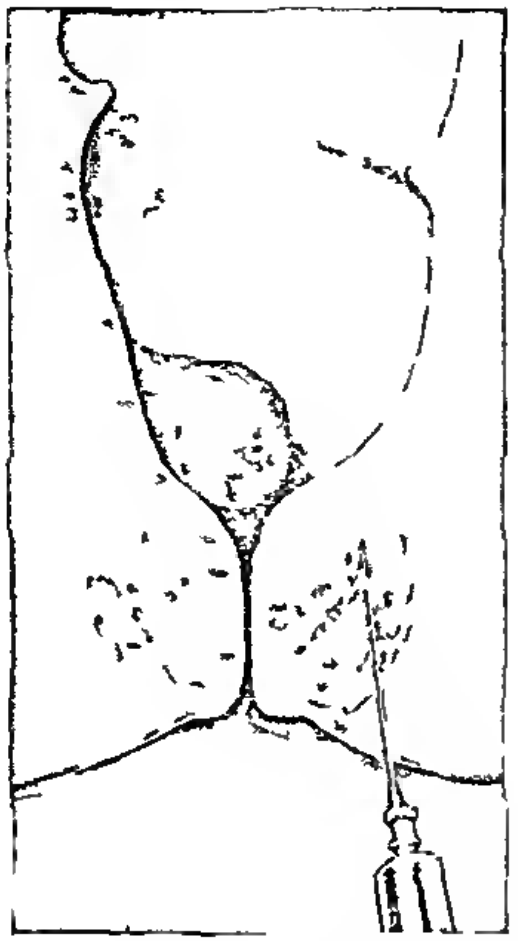

Fig 118 The needle is shown passed to the proper depth to infiltrate the external sphincter muscle

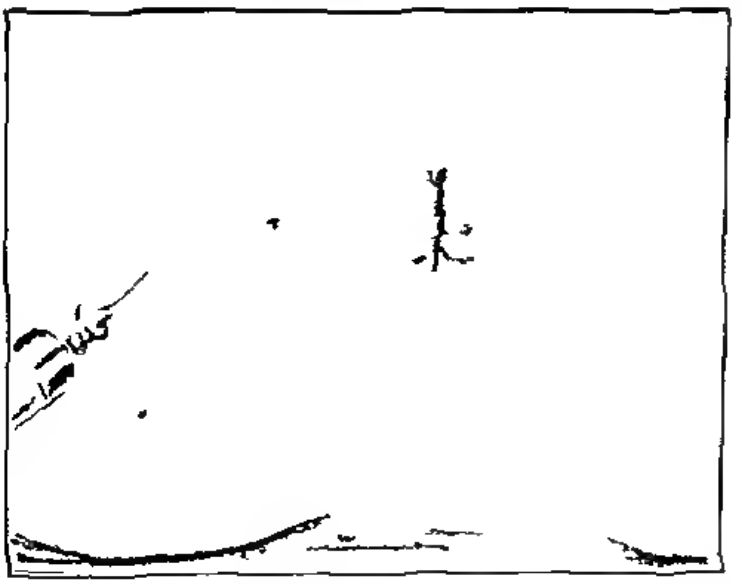

Fig 119 Line of infiltration in the skin for fistula in ano

Fissures of the Anus—In very small fissures a simple injection of the anesthetic about the base permits of excision In the larger and more complicated, it is better to do a typical operation, which requires the dilatation of the sphincter as advised for the removal of hemorrhoids The affected area may then be excised and the defect closed by suture Quinine is the anesthetic of choice because of the very intense after pain when more ephemeral anesthetics are used

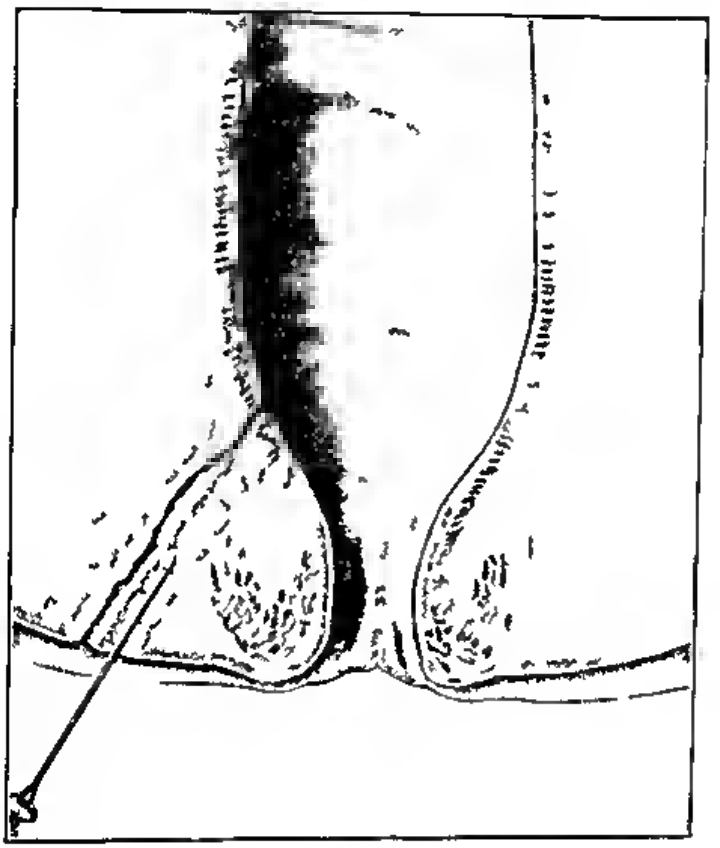

Fig 120—The tissue about the fistula is infiltrated throughout its length

Carcinomas of the Rectum

Carcinomas situated low in the rectum, that is, when their upper border can be well circumscribed by rectal palpation, are easily removed under local anesthesia Those situated higher up cannot be so removed and low spinal anesthesia is by all odds the anesthetic of choice It not only gives good anesthesia but also prevents shock

The first part of the infiltration for carcinoma is done in the same way as for the removal of hemorrhoids After this has

been done, the tissues higher up are infiltrated The insertion of the levator is the essential area requiring infiltration and in the male the tissue between the rectum and the prostate For this part novocaine epinephrine is preferable It is not difficult to infiltrate the perirectal tissue if the needle is long enough to reach the sensitive area A needle at least four inches long is required The finger in the rectum gives the operator a definite notion of the presence of the point of the needle It is possible in this way to anesthetize the pararectal tissue as high as the promontory

The rectum is circumscribed either removing the sphincters or leaving them, depending upon the situation of the carcinoma The levator is then encountered and should sensitiveness remain

Fig 191 —Quinine injection in pruritus ani

it may be infiltrated anew With experience this necessity will not arise If gentle traction is exercised after the levator has been cut, it will bring the mesentery into view, and if this is cut high up, it is possible to bring down tumors situated quite high When the tumor has been delivered out of the perineal wound it may be excised without fear of causing the patient pain

Pruritus Ani

This troublesome affection may be controlled by the injection of the affected region with a 1 per cent solution of quinine urea hydrochloride Endermic injection is most effective If it is used with care, there is no danger of sloughing Subdermic injection is easier but less effective Excision of the affected area is still more effective

CHAPTER XXIII

OPERATIONS ON THE UPPER EXTREMITIES

Spinal anesthesia obviously cannot be employed for operations on the arm as is done for major operation on the leg One must resort therefore to nerve blocking or infiltration Fortunately these methods are more easily employed in this region than in the lower extremity

Infections of the Arm and Hand

Localized infections may be anesthetized by circumscribing the inflamed area with a novocaine epinephrine solution Very gentle pressure should be exerted for sudden increase in the tissue tension causes acute pain In opening subcutaneous abscesses where the skin is not directly affected the line of incision may be injected directly over the abscess beginning in the healthy skin on one side of the lesion and then gradually extending over the site of the abscess Subfascial inflammations require in addition deeper injections about the affected area For the more serious infections about tendon sheaths and in the subfascial tissue local anesthesia should not be used In such cases the extent of the disease often cannot be ascertained exactly before the operation and at best anesthesia in inflamed tissue is difficult to obtain Furthermore patients suffering from such infections are usually irritable because of previous suffering In all deep and extensive infection nitrous oxide gas or light ether is by all odds the anesthetic of choice

Fractures and Dislocations

An American Conway was the first to employ local anesthesia in fractures and dislocations

The difficulty encountered in the reduction of fractures is due to the muscular spasm produced reflexly by the injured tissues When the damaged areas are anesthetized the spasm subsides but may return as the anesthesia disappears *This fact must*

be kept in mind in placing splints, for the apparatus which holds the fractured ends in place during the duration of the anesthesia may be inadequate after the anesthesia disappears This applies particularly to fractures of the humerus In most cases, however, fractures which are properly reduced and splinted remain reduced

The first advantage of local anesthesia in the reduction of fractures is that the patient is saved the unpleasantness of ether Further, unlimited time is allowed for the reduction of the fracture and with the same anesthesia the splint may be applied, examination under x rays taken and the splint reapplied if nec

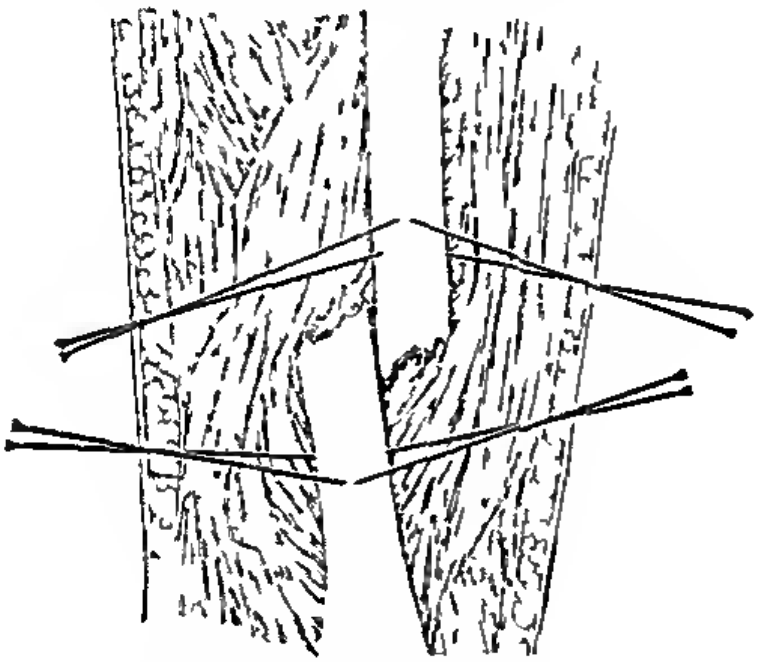

Fig 122.—Method of infiltration about the end of bone in fracture

essary In fractures in which the skin has been bruised the needle should pass through uninjured skin, and if the injury to the surrounding soft parts has been considerable, the case should be considered unsuitable for local anesthesia

The technic is simple The skin is sterilized with iodine and a solution of novocaine epinephrine, ½ per cent is injected about the ends of the fractured bone If there is displacement of fragments, each fragment must be circumscribed with fluid It is preferable to make the injection from two points diametrically opposite (Fig 122) in order that the periosteum may be reached

at all points Thirty or more cubic centimeters are required About twenty minutes is required for complete anesthesia to take place

Injections into the joints to facilitate reduction or manipulation are less often useful in arm joints than in those of the lower extremities, but they may be useful here particularly for the manipulation of sensitive joints

Deutschlander warmly recommends joint injections for the manipulation of fixed joints and for operations He regards a bloodless field as essential and employs the same technic to secure this as is recommended for Bier's venous anesthesia My experience has been that the constriction required to secure the necessary anemia is intolerably painful to the patient Intracapsular injections are not effective in adherent joints when there are extensive adhesions within or about the joint, but in recent adhesions gentle manipulation continued over a prolonged period is possible

My own practice is to limit intracapsular injections to cases in which injections of formalin glycerin are to be used I aspirate the joint if it contains fluid and inject 5 per cent quinine solution I allow this to remain twenty minutes, withdraw it, and then inject formalin glycerin after Murphy's method The quinine produces a considerable degree of anesthesia and in gonorrheal arthritis the quinine may have some effect on the disease itself I have used quinine injections directly into the joint for the relief of pain in gonorrheal joints, and in those cases in which it was used the process ran a much shorter course than usual

Operations on the Hand and Fingers

No region requires a more delicate technic if the patient is to be spared needless pain A fine new sharp needle is indispensable The dull pointed needles on the market expressly for use in local anesthesia are unsuitable A small syringe must be used, preferably a glass one of 1 c c capacity The large syringes are unsuited, because very slow injections cannot be made with instruments of large diameter

Amputations—In amputations of the distal phalanx, or in opening abscesses in this region, the skin about the base of the

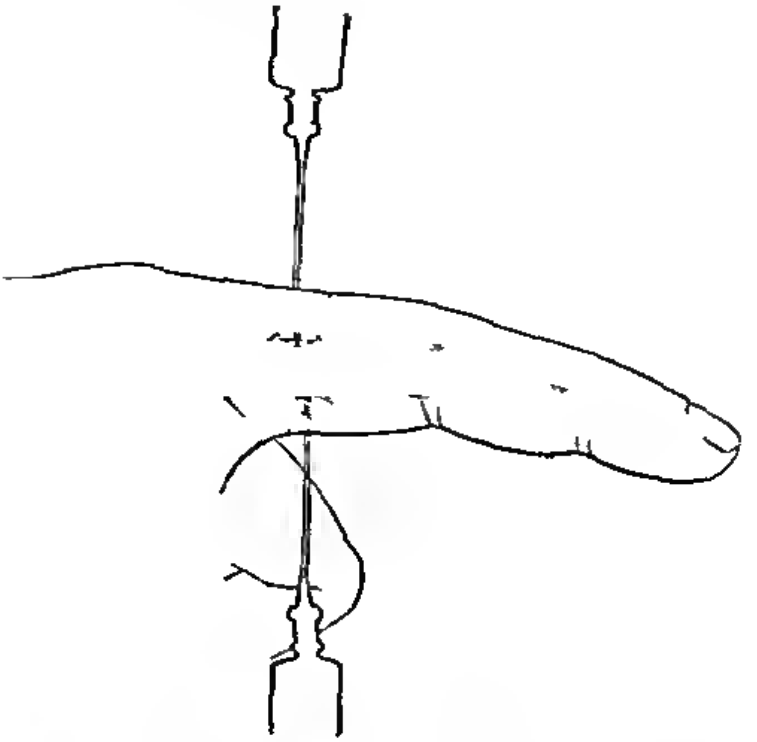

Fig 123.—Injections about finger into region of digital nerve

Fig 124.—Ring line indicates the skin infiltration. The needles show direction of blocking the nerve trunks.

finger is first infiltrated, beginning at the dorsum, because this is the least sensitive part, and proceeding toward the palmar surface After a complete ring has been infiltrated, the digital nerves are blocked (Fig 123) On each side of the bone the needle is passed downward and inward The dorsal nerve is encountered near the central plane of the bone and the ventral opposite the flexor tendons

Fig 125—Lines of skin infiltration on the palmar surface corresponding to the dorsal infiltration in Fig 124

When the first phalangeal bone or the metacarpophalangeal joint, is to be attacked, the line of skin infiltration begins on the dorsum of the hand an inch or two above the joint Diverging lines are infiltrated which terminate in the webs on each side of the finger (Fig 124) When the web has been reached, a similar triangle is described on the palmar surface in the reverse direction, terminating at a point opposite the point of beginning (Fig 125) The nerves are now blocked by pass

ing the needle downward from the dorsum on each side of the bone (Fig 126), and upward through the web parallel with the nerves it is intended to block If the metacarpal bone is to be attacked, the periosteum must be anesthetized This can be done most effectively by passing the needle along the bone from the web (Fig 126) Each finger to be operated on is injected in the same manner If several fingers are to be operated on at the same sitting the skin lines of infiltration to the web should

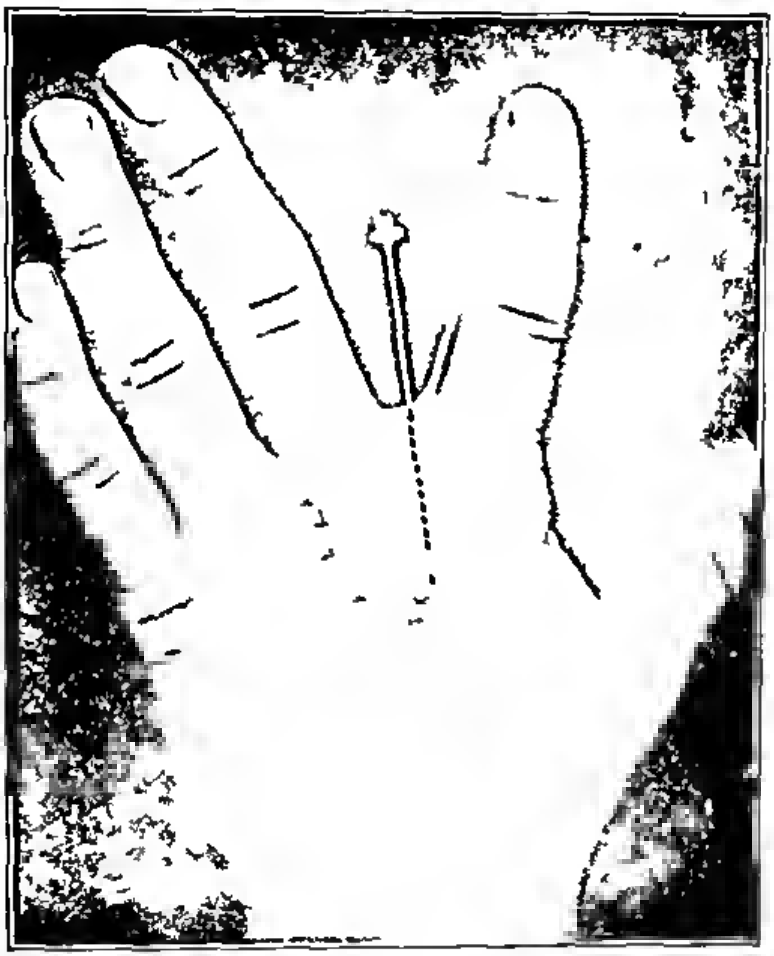

Fig 126—Infiltration of the periosteum when the metacarpal is to be attacked

be made to bound the field of operation, but the nerves on each side of the metacarpal bones must be blocked separately

For the operation upon the distal phalanx, anesthesia may be attained by the method just described instead of by circling the base of the finger, but in limited operations the latter method is simpler

Operations upon the carpal and proximal ends of the meta carpal bones must be preceded by blocking about or above the

wrist A circular line is infiltrated and from this the nerves supplying the region are infiltrated The extent of this infiltration must depend upon the extent of the operation If a single

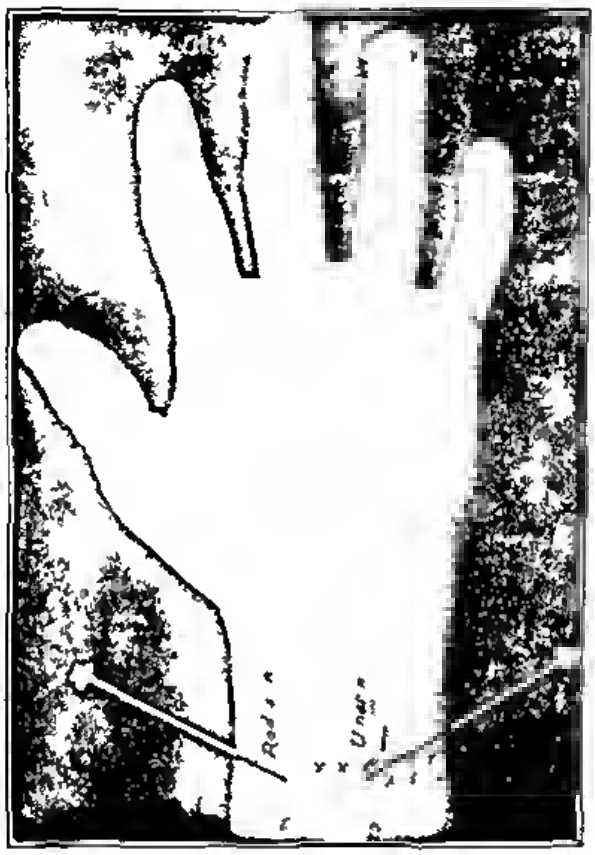

Fig 127—Circular injection about the wrist Needles showing line of block ing the radial and ulnar nerves

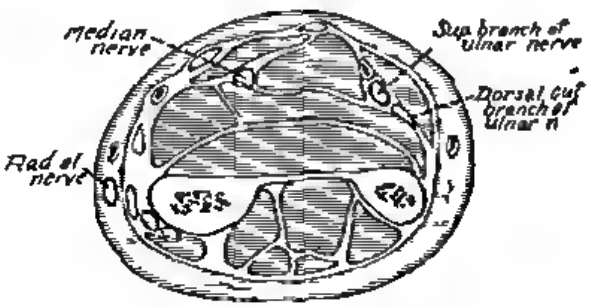

Fig 128—Cross section of the wrist showing the nerves to be blocked

metacarpal bone is to be attacked injection about its base from the circular line will be sufficient If more than one is to be attacked, each in turn must be similarly infiltrated

Instead of infiltrating about the bone to be attacked, the nerve trunks may be blocked above the wrist A circular line is first infiltrated in the skin and subcutaneous tissue (Fig 127) This blocks all superficial nerves in this region Through this primary line the main trunks are injected (Fig 128) This method

Fig 129.—Infiltration about the base of the metacarpal bone of the thumb The needles indicate the points for deep injection

of anesthetization is required for all extensive operations on the wrist and hand

For operations upon the metacarpal of the thumb this procedure may be modified *Instead of infiltrating* a line entirely about the wrist, this line is terminated over the carpometacarpal joint and the line continued to the web of the thumb, both

fore and aft (Figs. 129 and 130). From this line deep injections are made. This technic is useful also in certain dislocations of the thumb.

In lacerated wounds of the hand the skin injection is begun at one angle of the wound and from this point the injured area is circumscribed and the deeper tissue then injected. This

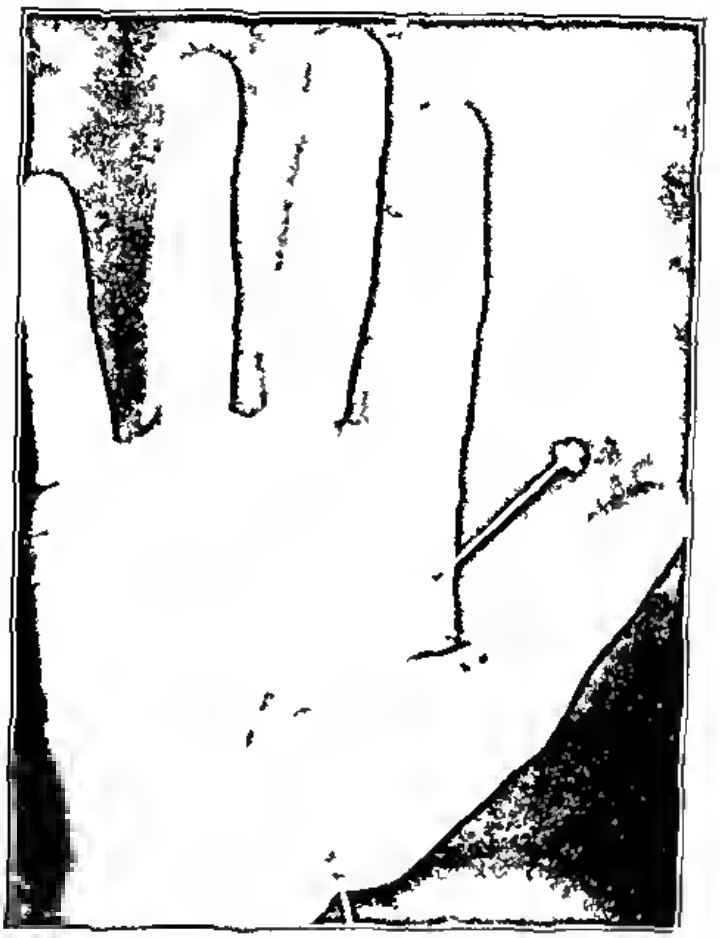

Fig. 130.—Superficial and deep injections on the palmar surface for operations upon the metacarpal bone of the thumb.

method of injection causes less pain and is less likely to cause infection than if the skin is injected from the edges of the wound.

Infection of the Fingers.—Superficial *infection may be in*jected directly in the line of the proposed incision but in more severe infections it is best to block off the entire finger as recommended for amputations.

If the operator will use judgment the patient may be saved many hours of acute suffering by using quinine for anesthesia

in opening abscesses If too much anesthetic fluid is injected, the circulation is disturbed and the necrosis of the disease augmented

Infections of the Palm—Simple isolated infections may be incised through a simple infiltration line in the skin covering them The diffuse infections should be done under gas or ether, or, if these are not available or are contraindicated, by blocking of the nerves above the area of infection, or by plexus anesthesia.

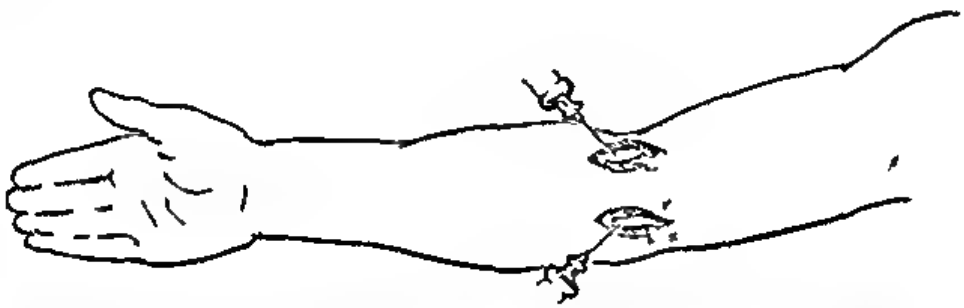

Fig 131—Circular injection of the arm with blocking of the nerve trunks above the elbow

Fig 132—Injection superficial and deep for operation upon the olecranon

Operations upon the forearm may be done following a circular infiltration above the elbow with subsequent blocking of the nerve trunks (Fig 131) When for some reason local anesthesia is necessary for large operations, they are better done under plexus anesthesia If the latter is incomplete, it may be supplemented by local infiltration

Bursae of the olecranon or abscesses or exostoses resulting from them, may be attacked, infiltrating a line about them and injecting deeply beneath them from this line (Fig 132) In

thickened bursae the needle can readily be passed between the cyst wall and the bone, but in recent ones this may not be possible In that event the border of the bursae is freely infiltrated, which secures ample anesthesia after a wait of ten minutes

On the whole only the minor operations on the hand can be classed as routine operations for local anesthesia Unless the operator is especially skilled the use of local anesthesia in major operations is liable to lead to incomplete operations

CHAPTER XXIV

OPERATIONS ON THE LOWER EXTREMITIES

Spinal anesthesia is particularly adapted to major operations on the lower extremity It gives good anesthesia and also prevents shock In lesser operations ether is the anesthetic of choice and is mandatory in children Infiltration is the anesthetic of choice in all minor operations

Fractures and Dislocations

In fractures local anesthesia is of minor importance, but it may be employed when there is urgent need to avoid inhalation anesthesia as in old persons with fracture about the neck of the femur or when fat embolism is present or feared In the simple fracture of the long bones it may be used as described for the arm if there is contraindication to ether or adequate help is not at hand In dislocations, likewise, there are but few indications The injection is made directly into the joint cavity from the most convenient point In hip dislocation Braun makes injections about the dislocated head and into the acetabulum by introducing the needle external to the anterior superior spine and following the bone into the acetabulum In the knee Deutschlander injects ½ per cent solution on each side of the ligamentum patella, injecting each half separately The infrapatellar region, the region of the crucial ligaments and the posterior recesses then receive attention (*a*, Fig 133) The needle is withdrawn so that the point remains just within the joint cavity and is then passed upward under or to the side of the patella into the suprapatellar portion of the capsule (*b*, Fig 133) After ten to twenty minutes reduction may be accomplished Pays used 80 to 100 c c with the express purpose of distending the capsule in order to facilitate reduction mechanically Generally speaking, the use of local anesthesia in fractures and dislocations has little place, for persons vigorous enough to acquire these injuries can take ether without risk

To facilitate movement in joints in which there is limitation of motion local anesthesia is more often useful than in dislocations The anesthetic solution is injected about the joint and

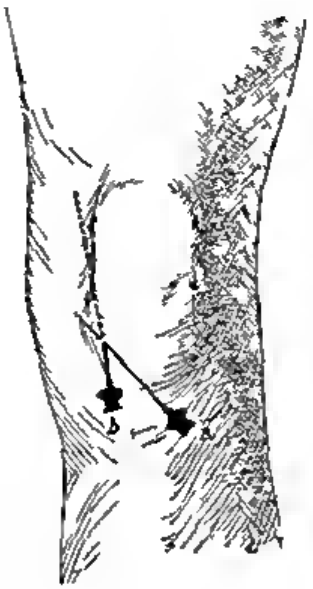

Fig 133 —Injection of the left knee joint *a* Injection of the posterior recess *b* subpatellar injection

directly into it The manipulations may then be done without producing pain I have used quinine and urea about gonorrheal joints with the greatest satisfaction

Operations on the Thigh

Nerve blocking may be employed for operations on the thigh and leg The sciatic the cutaneous, the anterior crural and the obturator must each be blocked in turn This requires great skill, large quantities of anesthetic solutions and the loss of considerable time because it is not possible to make injections directly into these nerves and diffusion is slow and uncertain I have not used this method since spinal anesthesia has proved to be certain and comparatively safe For major operations on the thigh spinal anesthesia is unquestionably the anesthetic of choice I have repeatedly amputated through the thigh for gangrene in patients who were so dyspneic from advanced cardiac disease that the patient had to be allowed to retain the sitting position during the operation I have had no deaths within a week after operation nor any attributable to the anes

thetic. In general spinal anesthesia should not be used in septic patients, but in the leg where extensive operations are required I much prefer to assume the hypothetic danger of the spinal anesthesia than face the certain shock of major operations between the trochanter and the midcalf.

Operations on the Leg and Foot

Operations on the leg and foot usually can most conveniently be done under general anesthesia. When there are contraindications to general anesthesia, either spinal anesthesia, nerve-

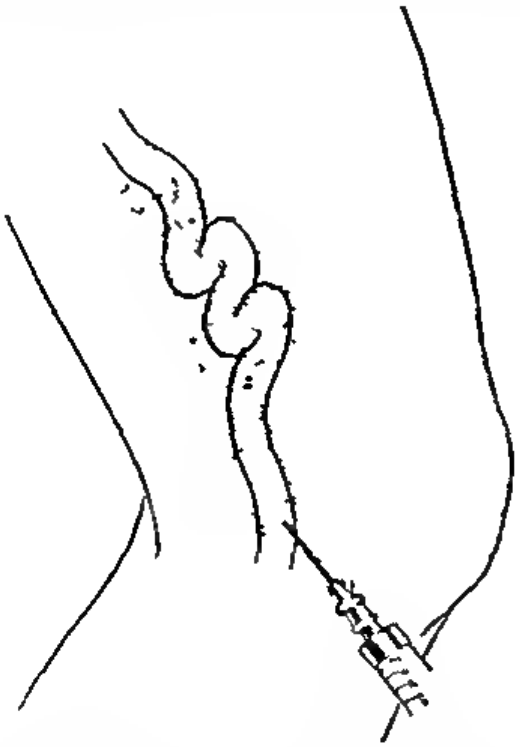

Fig. 134.—Infiltration of skin over a varicose vein.

blocking, or local infiltration may be employed. For amputations in gangrene where there is great pain due to the disease spinal anesthesia is the simplest. The same is true for extensive operations on the metacarpal bones. Operations upon varicosities and varicose ulcers may be done under nerve-blocking or local infiltration.

Varicose Veins and Ulcers.—Dilated veins and the ulcers resulting from them are frequent diseases in fat old women in whom ether anesthesia is to be avoided.

It may be necessary to resect the veins below the saphenous opening and also some segments about or below the knee. The

location of the chief offending vessels can be determined when the patient is on her feet The skin over the vein is infiltrated in the usual manner (Fig 134) The tissue about and below the vein can be infiltrated by sliding the skin first on one side and then on the other For this purpose a considerable amount of ½ per cent or less, is used in order to facilitate the dissection of the veins The vein should be dissected in plain sight so that collaterals may be seen before they are cut They should all be ligated, for while they may not bleed at the time of operation, they may do so later If the vein from previous periphlebitis has become adherent to the subcutaneous tissue it is best to infiltrate an ellipse about the mass and excise it as a whole For the removal of a varicose ulcer the solution is injected about the border of the ulcer (Fig 135) through approximately normal skin From this line the periosteum is infiltrated over the entire base of the ulcer, a procedure which is made difficult by the presence of a considerable amount of fibrous tissue If the ulcer is large and consequently curved, it may be necessary to make some of the infiltration through the base of the ulcer When the infiltration is complete, the skin is incised in the line of the first injection, and the ulcer is dissected from its base with its floor intact The ulcer thus excised forms a flat saucer

In preparing the bed of an ulcer for skin grafting, a small amount only of epinephrine, say two drops to the ounce, should be used, so as to produce the least amount of constriction of the vessels and allow a quicker recovery of their normal tone One must depend upon the exudate from the vessels to supply the preliminary fixation of the graft In operations of this kind it is well to prepare the ulcer as the first step By the time the varicose veins have been resected and the area from which the new skin is to be secured has been prepared, the vascular tone in the new bed of the excised ulcer will be to a certain extent restored With all this precaution there will be a greater percentage of failures than under general anesthesia

The method of preparing the skin from which the graft is to be taken may be varied according to the size of the graft If

it is small, the area from which the graft is to be taken may be infiltrated subdermically and surrounded by a horseshoe shaped endermic infiltration

For large grafts the same method may be used or the nerves to the area may be blocked The nerves concerned are the

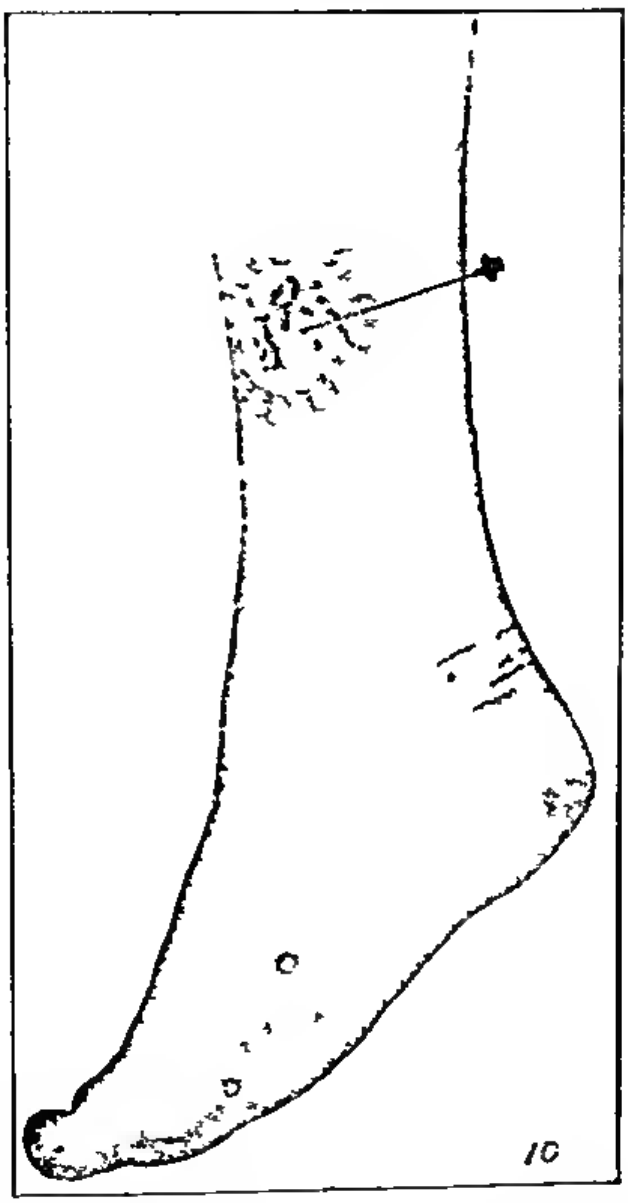

Fig 130—Superficial and deep injection for the removal of varicose ulcer of the leg

lateral cutaneous, femoral and the anterior cutaneous The former emerges medial to the anterior superior spine and below the Poupart's ligament In order to block it, Lawen suggests that the most favorable point is two fingerbreadths downward and inward from the anterior superior spine Two or three c c

of the solution are deposited above and below the fascia, the needle being directed downward and outward To reach the anterior crural nerve, Lawen gives the following directions the femoral artery is located by the finger at its emergence be low Poupart's ligament The needle is passed one and one half cm lateral to this point perpendicular to the surface until it penetrates the fascia lata While the needle is passing, 5 c c of a 2 per cent solution are deposited Puncture of the nerve, which should be done if possible, is manifested by a contraction of the rectus femoris After the nerve has been penetrated, the fluid is deposited

When the nerves have been successfully blocked, a large area is made anesthetic This method has the advantage over direct infiltration of the skin that the capillary circulation is not inter fered with Its disadvantage lies in the fact that it is not al ways certain that the nerves will be effectually blocked, espe cially in fat persons For this reason I employ the method first mentioned

Patellar Bursitis—For the treatment of this common affec tion one injects first a line of skin around the base of the swell ing and, second, through this line the periosteum beneath the bursa (Fig 136) The second step is especially easy if the periosteum has become thickened by prolonged inflammation In recent cases where the thinness of the tissue may make this uncertain, the fluid from the cyst is replaced by a 5 per cent quinine solution The bursa is then dissected out in the usual way

Ganglia about the knee are removed by infiltrating the skin over them and the surrounding tissue Sometimes their deep attachments remain sensitive and require a secondary infiltra tion during the course of the operation

Tumors—Many tumors of the soft parts may be removed un der local anesthesia It is best to infiltrate about them without regard to the nerve supply Tumors with deep attachment should be undertaken with caution and the operator must be prepared to infiltrate periosteal or deep fascia attachments

Blocking of the nerves of the leg in a manner analogous to plexus anesthesia in the arm is not possible because of the numerous avenues of exit of the nerves supplying the leg The

sciatic may be reached at a point slightly medial to the center of a line between the trochanter and the tuberosity of the ischium Large tumors in the adductor region should not be attacked under local anesthesia

Amputation of the Toes—The amputation of toes is accomplished in a manner similar to that described for amputation of the fingers Since amputation of the toes is rarely performed distal to the metatarso phalangeal joint, the triangular infiltra

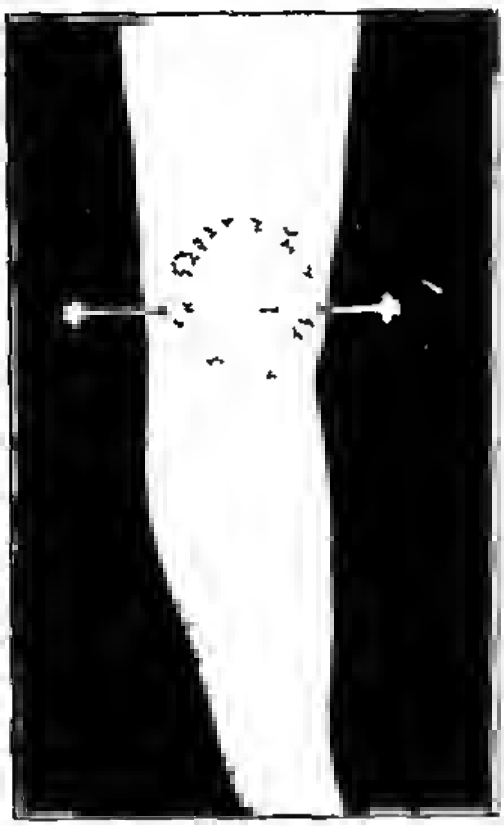

Fig 136—Superficial and deep infiltration for removal of the prepatellar bursa

tion over the dorsum and plantar surfaces with deep infiltration from these lines is the method usually employed

Near the base of the metatarsal joint an infiltration line descends to the web on either side of the toe or toes, which are to be operated upon (Fig 137) From the point of termination of these lines at the web other lines are infiltrated upon the sole to terminate at a common point opposite the point of beginning on the dorsum From the web line deep infiltrations are made along the bone, as shown in operations upon the fingers From the point of beginning on the dorsum the deeper tissues are

infiltrated, extending through the foot to the sole, as shown in operations on the hand This gives an anesthesia which permits the shaft of the metatarsophalangeal disarticulation or amputation through the shaft of the metatarsal, as is required in metatarsalgia Amputations of the great toe may be done under the technic advised for bunions

Injuries to the Foot—Puncture of the foot particularly the sole, by nails or other foreign bodies, is one of the most frequent

Fig 137—Dorsal line of infiltration for amputation of the toes

surgical lesions encountered by the general practitioner The frequency with which tetanus follows these injuries makes their proper treatment of the greatest importance If the wound is fresh it is imperative that the entire tract be exposed immediately and *that the entire* area which came in contact with the foreign body be thoroughly cauterized and the wound packed This procedure demands a careful anesthesia If the wound be clean, the needle may be introduced along the tract of the for

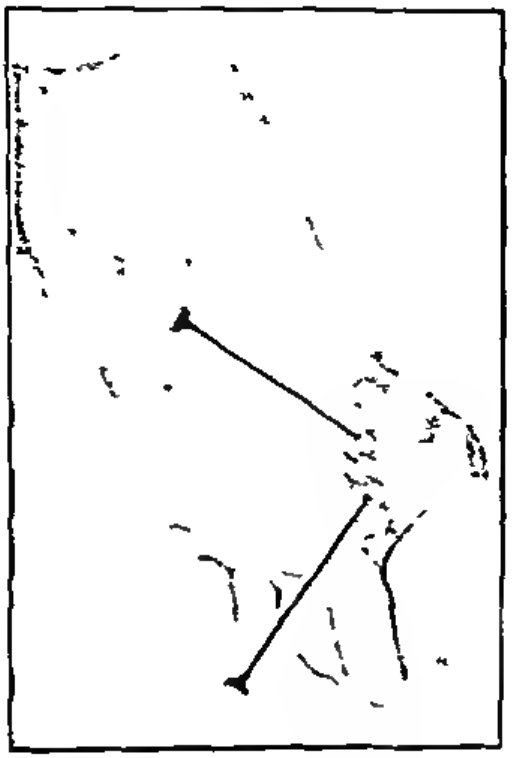

Fig 138.—Superficial and deep dorsal infiltration for hallux valgus.

Fig 139.—Plantar infiltration for hallux valgus

eign body and the infiltration begun in the subcutaneous tissue This method saves a preliminary puncture of the thick and sensitive skin but it is open to the objection that infection present in the wound may be carried to the deeper structures Some idea of the depth and direction of the puncture must be obtained *from the history of the injury* in order that an area large and deep enough may be infiltrated If the wound is deep extending to near the dorsum it may be advantageous to begin the

Fig 140 Deep infiltration for the web of the toes

infiltration on the dorsum and gradually approach the site of the wound on the sole The dorsum is less sensitive and the skin less resistant Often by these means it is possible to operate on children who would not permit the *operator to force the* needle through the resistant plantar skin This applies particularly to boys who have been going barefooted

Wounds already infected can more frequently be satisfactorily opened under local anesthesia in the foot than in the

hand, because of the lesser tendency for the infection to follow the tendon sheaths The infiltration must begin in healthy skin and the infected area gradually be approached or circumscribed, depending on the degree and character of the infection Infections following the tendon sheath, like those of the tendon sheaths of the hand demand general anesthesia

Hallux Valgus—From a point two inches above the joint on the medial border of the foot to a point between the metatarsal

Fig 141—*Infiltration of the skin in the line of in ion* At *a* and *b* infiltration is made above and below the tendon

bones to the web of the toes the skin is infiltrated (Fig 138) From the same point a line is infiltrated over the inner border of the foot to a point on the sole corresponding to the point of beginning (Fig 139) From the terminal point of the first infiltration on the web a line is now injected to the point on the sole of the foot From the first point injected the interossens nerves are blocked and the periosteum is infiltrated From the

point on the sole of the foot the periosteal tissue is likewise infiltrated This may be accomplished by injecting from the webs of the toes (Fig 140) This operation deals with sensitive tissue and a considerable amount of the fluid, usually 40 to 50 c c of a ½ per cent of novocaine epinephrine solution should be used

The Tendo Achillis—Operative lengthening of this tendon is usually part of a serious operation not usually undertaken under local anesthesia Rupture of the tendon offers a more frequent object for the employment of local anesthesia It is

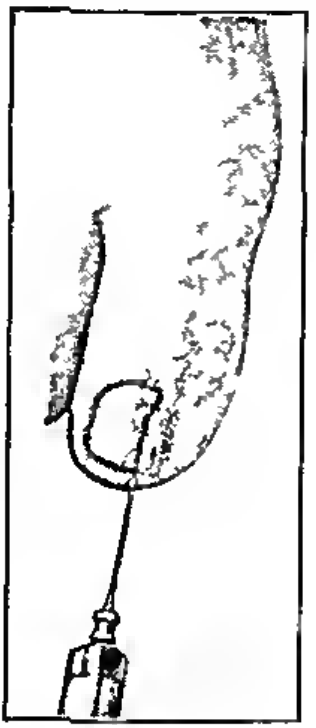

Fig 142—Infiltration of the nail

desirable that the skin incision shall not fall directly over the repaired tendon A curved line, therefore, is infiltrated from a point over the tendon, beginning two inches below the site of injury, curving outward over the tendon, two inches above the injury (Fig 141) From the points of beginning and termination of the line the tendon is circumscribed with fluid By sliding the skin both sides of the tendon may be reached by the needle without making a new puncture in an unanesthetized area The area below the tendon can best be reached from a point in the original line where this crosses the furrow below

the tendon By making the incision along the line of the original infiltration a flap is formed which, when returned after the repair is made, places the line of incision outside from the recently repaired tendon

In open injury of this tendon and others of the foot an ellipse should be circumscribed an inch or two from the site of injury From this line the deeper tissues are infiltrated

The minor operations of the foot may be done with local infiltration

Ingrowing Nails—This condition which almost always affects the great toe may be satisfactorily done under local anesthesia The sensitiveness of this region is usually heightened by the inflammation present, necessitating the gentlest possible manipulations Anesthesia is secured by beginning at a point midway between the joint and the nail and injecting a line along the soft parts outside the nail corresponding to the base of the overhanging soft parts (Fig 142) This line is continued until the extremity of the toe is reached The space beneath the nail is then infiltrated by beginning at the distal end of the nail and proceeding to its base After the lapse of a few minutes complete anesthesia will have been obtained and the operation may proceed

Instead of the method above described a circular line about the base of the toe may be injected and other nerves leading to the diseased area blocked by deep injections at the base of the toe, as shown for operations on the fingers

CHAPTER XXV

INTRAVENOUS ANESTHESIA

RAYMOND F GARD M D

Various experimenters in their search for a satisfactory anesthetic that would eliminate for the patient the unpleasant and often terrifying experience of an inhalation anesthesia have used a large number of barbituric acid compounds The clinical use chemistry and pharmacology of the more important of these has been reviewed recently by Lundy and Osterbert and need not be discussed here Of these barbiturates one sodium iso amylethyl barbituric acid (sodium amytal) has received much attention in the past few years Amytal was first introduced by Page in 1923 for use in laboratory experimental work Since that time its scope of usefulness has increased to include major surgery obstetrics and to control the convulsions of eclampsia cocaine poisoning tetanus epilepsy etc

Sodium amytal is primarily a hypnotic or sedative and if given alone huge doses are required to produce adequate anesthesia for major surgery Such large doses are often followed by uncomfortably long periods of sleep from which the patient cannot be aroused This period of depression is characterized by slow shallow respiration which seems to predispose to pulmonary edema and bronchopneumonia Following doses sufficient for surgical manipulation there may be a period of ex*treme restlessness and delirium*

To avoid such unpleasant postoperative effects amytal may be given in conjunction *with other anesthetics e g gas local* novocaine or ether and in such combination the dose of each drug is materially lessened The preliminary dose of sodium amytal may be given in the patient s room rapidly and quietly produces unconsciousness and relaxation and the supplementary anesthetic supplies analgesia

Sodium amytal may be given by mouth rectum intraspinally intramuscularly intraperitoneally or intravenously with similar

effect Of these routes, that by mouth and vein are the most frequently used When used as a sedative the oral administration is preferred When used for anesthesia it is best given by vein since this is the most rapid route of absorption and the dosage can be more accurately controlled

In this clinic the use of sodium amytal has been limited to those cases in which ether cannot be conveniently or safely given—particularly in those cases requiring cauterization within the mouth It is used only in conjunction with a preliminary dose of morphine In each case in which it has been used anesthesia has been entirely satisfactory, the period of postoperative unconsciousness has averaged about six to seven hours and delirium or unusual restlessness has not occurred

The technic of the administration of sodium amytal is largely a matter of determination of dosage, which depends to a great extent upon the effect desired The dose varies with individual patients, some requiring much more than others to produce similar results From experience in this clinic and from the literature it seems that the maximum dose for an adult patient should not exceed 1 5 gm (22½ grains) There is no definite information in regard to the lethal dose for man, but when the average dose of 20 25 mg per kilogram weight is greatly exceeded, a decided fall in blood pressure occurs and the period of postoperative unconsciousness increases The amount given should be determined to a large extent by the behavior of the patient during the time of injection The usual amount prepared is 20 *mg* per kilogram of body weight The pure anhydrous sodium salt of amytal is supplied in ampules of 1 0 gm (15 gr) each and with this there is an ampule containing *10 c c of sterile distilled water The amytal dissolves readily* and produces a crystal clear solution Usually more than 15 gr. will be required and two ampules should be opened and the solution made and drawn up into two 10 c c glass syringes fitted with small sharp hypodermic needles

The evening before operation the patient is weighed The usual evening preoperative measures preceding any general anesthetic are carried out and a mild sedative is given to insure a restful night One hour before operation the adult patient is given one quarter grain of morphine. When the patient arrives

in the operating room a cubital space is painted with iodine and this removed with alcohol The blood pressure cuff is applied to this arm and the patient made as comfortable as possible Now the cubital vein is picked up with the small hypodermic needle and the injection of the sodium amytal is begun Not more than 1½ gr should be injected in a minute After about 5 gr have been injected, the patient usually ceases talking, may yawn or complain of some dizziness After another 5 gr the patient is unable to respond to questions, but if painful stimulation is applied will move or cry out By the time he has received 10 gr the patient is usually snoring and the tongue has a tendency to fall back with partial obstruction to breathing During this stage operation is not possible for the patient is simply asleep and still retains sense of pain Blood pressure readings during this stage are normal or slightly elevated The pulse and respiration may be slightly quickened The reflexes are ordinarily still present

The injection is continued and after 15 gr have been introduced there begins to be a delay in response to painful stimuli The reflexes gradually disappear, those of the pharynx and sphincters seem to remain longest When a dosage of 18 to 25 gr has been reached the patient is in a stage of anesthesia and the operation may be begun There may be slight cyanosis, the respiration is slow and shallow and the heart rate may be slowed The blood pressure has by this time begun to fall and the systolic reading should not be permitted to go below 90 mm Hg When the pressure reaches this point, the injection should be immediately stopped and usually the pressure soon rises particularly when the stimulation from the surgery begins At this time it is often necessary to use the airway because of the relaxation of the pharyngeal muscles just as in any other general anesthetic With such a dosage of amytal and morphine one can expect a thirty minute period of perfect relaxation If more time is required, more of the drug may be injected provided that the blood pressure is not depressed below 90 mm systolic Dosage as high as 45 grains has been safely given

After the operation is ended the patient must be cared for just as any other patient having had a general anesthetic Particular attention should be paid that the tongue does not

obstruct the breathing Nausea and vomiting seldom occur Restlessness should be controlled with morphine Occasionally patients are unable to void and should be catheterized

The biggest objection to the use of amytal is that there is no antidote and once within the vein it cannot be retrieved There is no certain way of counteracting the postanesthetic effects This can be accomplished to a degree by the injection of 7 to 15 gr of caffeine sodium benzoate along with 75 to 100 mg ephedrine sulphate

The ease and rapidity with which patients are anesthetized and the absence of postoperative nausea and vomiting are decidedly advantageous clinical features of sodium amytal anesthesia It is the ideal anesthetic for cautery work about the mouth However, it must be remembered that the drug is an hypnotic only and its use alone in doses large enough for complete anesthesia is hardly justifiable

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